EER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

The Welding Engineer

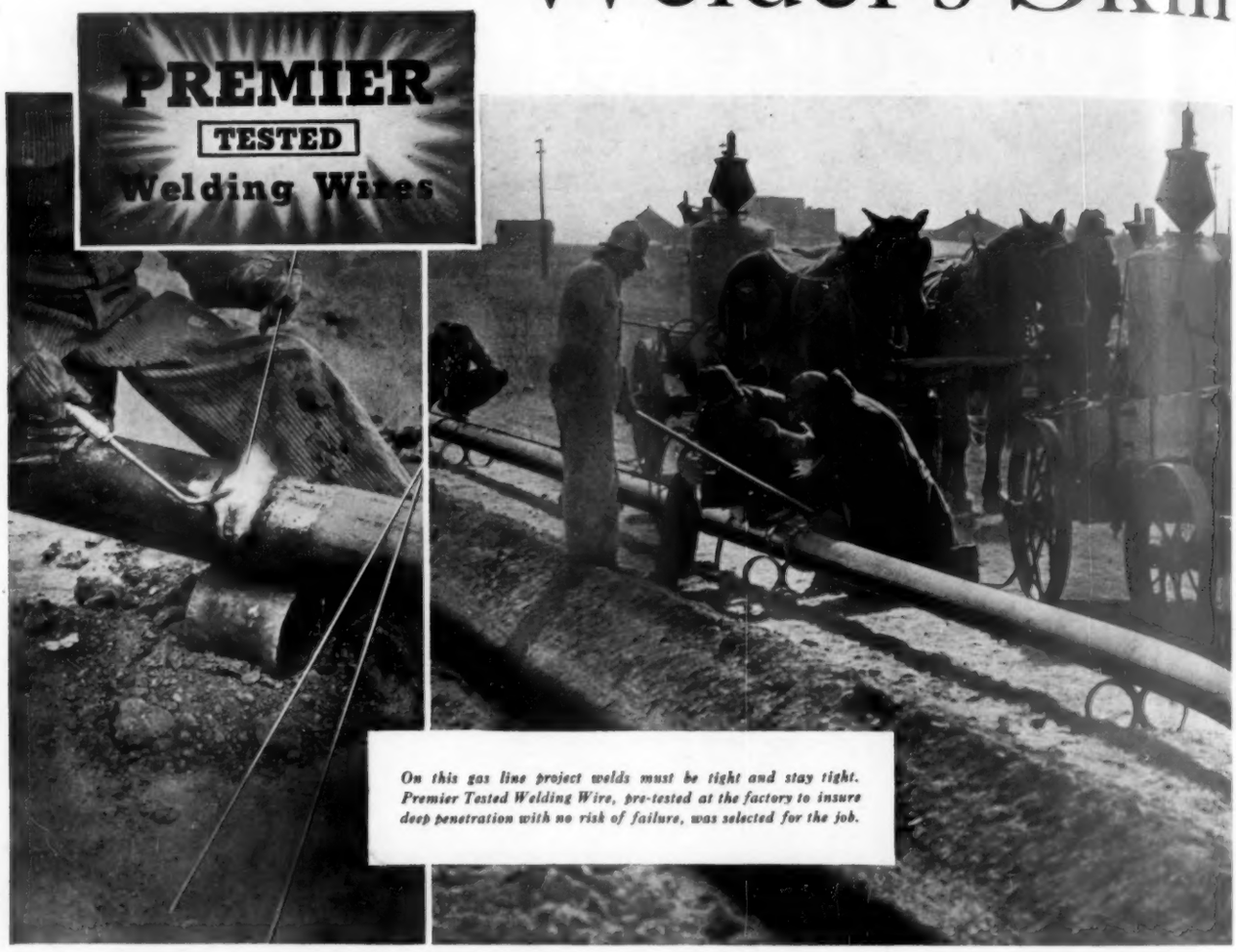
Reg. U. S. Pat. Office

e XXI July, 1936 Number 7

SEA-GOING tugboat "Resolute" with all-welded hull of steel and wrought iron.

(See Page 20)

Back of the Welder's Skill



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THE WELDING ENGINEER

Vol. 21, No. 7 JULY, 1936

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EDITORIAL

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Interpreting Contract Clauses Relating to Qualification of Welders

● Federal Government specifications covering work involving welding are not clear as to the qualification tests that are required for testing welding operators. For several years such specifications have made mention of the American Bureau of Welding tests, and the specifications today still make reference to the Bureau.

The Bureau's name is connected with certain qualification tests, because under the date of September, 1931, the Bureau published a report of its Structural Steel Welding Committee, in which two sets of qualification tests were described, one of these being the test which the Committee itself used in qualifying welders in carrying out its investigation, and the other being a recommended test based on the Committee's experience.

The former test comprises tensile tests of butt-welded specimens. However, during the progress of its investigation, the Committee pointed out, it became evident that a fillet-welded specimen would be better suited to structural work. Hence, the Committee, in Section 8 of its report, recommended a tension test employing only fillet welds and comprising a butt joint with butt straps, either end-fillet or side-fillet welds being optional.

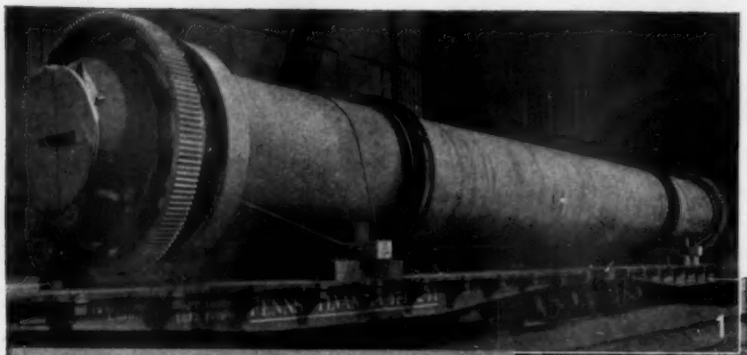
The Committee's report was never officially endorsed by the Bureau and hence the Bureau has not gone on record as favoring any specific qualification tests. Hence, "recommended tests of the American Bureau of Welding" really do not exist, and to add further to the incongruity, the Bureau itself passed out of existence a year ago last spring.

The interpretation of this clause, appearing in Government contracts, has been left quite largely to the inspectors' offices in the various districts. Naturally, some confusion has arisen, even among the inspectors themselves, but finally they adopted the butt-weld tests used by the Structural Steel Welding Committee, and all contractors were required to employ butt-welded specimens to qualify their operators.

Again, in the last year or two these qualification tests have been changed on the part of Government inspectors, who are now requiring fillet-weld tests for qualification purposes, these tests being a slightly modified form of the end-fillet-weld test recommended by the Structural Steel Welding Committee. All of this may seem rather confusing.

However, there is one way to simplify matters: Those who are interested in qualifying welders for Government work should consult Appendix 2 of the Code for Fusion Welding and Gas Cutting in Building Construction of the American Welding Society (Edition of 1934), wherein they will find, in detail, the fillet-weld tests now required by Government inspectors for qualifying welding operators. These tests appear in no other report.

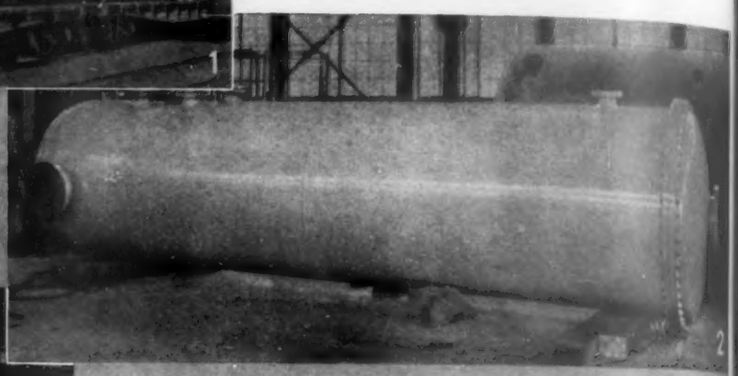
For the benefit of all concerned, the Government should omit in its contracts any reference to the Bureau's tests, and should include in detail the qualification tests that at present are being required. Only in this way can confusion be eliminated.



1. Blaw-Knox rotary carbonizer, 7 ft. I. D. by 75 ft. 2 in., welded with Murex.

2. Vacuum fractionating tower, 60 in. diameter by 22 ft. 4 in., welded with Murex by Blaw-Knox.

3. 2000 gal. jacketed vessel with multi-turbine agitator, welded with Murex by Blaw-Knox.



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The Welding Engineer

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Small Oxyacetylene Outfit at Home Provides Useful Hobby . . .

By A. W. SWIFT

IF A person is interested in hobbies and has a mechanical inclination, the purchase of a small oxyacetylene welding outfit will prove both interesting and valuable. All manner of metal articles can be fabricated or repaired with the welding torch.

The writer acquired such an outfit several years ago, and one of the first problems facing him was the need for a stand to hold a baby bath-tub. This was easily made up of ⅜-in. pipe welded into a frame, and 16-gauge steel for the flat surfaces. With a cutting torch, a hole was cut into the top of the stand to fit a standard baby bath-tub. Under this was a shelf for towels, soap, baby clothes, etc.

Two other stands or tables were constructed of ⅜-in. pipe and sheet steel—a table for the children and a stand for a wash tub. The pipe joints were welded and the sheet metal was tack-brazed to the pipe frame.

A window box for flowers was wanted, so it was welded up out of sheet metal and the top edge braced with ½-in. angle iron. When painted, it presented a very neat appearance.

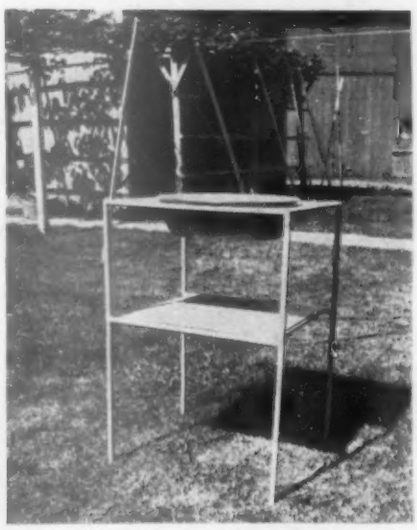
Then a welding table was built of 1-in. angle iron with about three-quarters of the top laid out to hold firebrick, and one section a wood-working surface. A shelf underneath holds tools and supplies.

A collection of copper cooking utensils made a pan rack seem necessary, so one was fabricated of brass angles brazed with a low-flow-point silver-alloy rod. The mentioning of work around the home on brass and copper brings to mind a picture frame welded from brass angles, a small brass and copper shelf for knick-knacks, and supports for book shelves made of brass angles and bronze rod brazed with a low-melting-point brazing alloy.

The Boss's Welding Table.

When one of the copper pans boiled dry and the solder melted from around the handle, it was cleaned off and brazed with one of the low-melting-point brazing alloys.

Another job on copper and brass which was started at home was the making of an all-copper corn popper. The pan was made of sheet copper with the corners low-temperature brazed. The lid was made of brass angles, silver-alloy brazed, and the handle was regular bronze brazing rod, low-temperature brazed. The copper screen in the lid was soldered at first, but we soon learned that the heat of popping melted the solder, so the screens were low-temperature brazed to the brass lid with a fine silver-alloy wire.



Baby's Bath Needed a Stand.

It is impossible to recall all of the little jobs which have been done around the home with the welding torch during the past two years, but an attempt will be made to list a dozen or more as an

Miscellaneous Repaired Articles.
(A chair, a table, a copper pan, and two bud vases made by welding copper tubes to flat copper bases.)

The Cook Wanted a Pan Rack.

indication of what can be done:

A cast-iron grate shaker handle was found to be broken. It was easily brazed with a good bronze rod.

A brass door knob, which had originally been soldered, broke loose, and it was brazed with a silver-alloy wire.

While living at a summer cottage along a river, dock supports were needed, so some were welded out of scrap 2-in. pipe.

When a special pipe fitting was required, two cast-iron fittings were cut and then bronze brazed together.

An old drain pipe had rusted out, so another was fabricated and welded in.

A towel rack of brass came loose from the wall support, but a drop of low-temperature silver-alloy brazing rod fixed it for good.

A lug on the bench vise was broken, but quickly repaired with a good bronze rod.

The plumber came to put a new water-heating coil in the furnace, but the fittings had become so tight that he could not move them. A minute's heating with the oxyacetylene torch loosened them up nicely.

A cracked fender on the car was easily brazed from the under side so that very little of the paint was burned and no grinding was needed to prepare it for repainting.

The children's wagon was made of crimped sheet steel, and the wheels began pulling loose from the body. A few touches of bronze at the right places made it twice as strong as it was when new.

A small part of the baby carriage was of this same crimped construction, and pulled loose. Here a drop of silver brazing wire at the right spot fixed it for good.

Many toys were repaired, including tricycles, toy engines, wheel-barrows, cap guns, etc.

The two-year-old boy knocked his high-chair over and broke the wooden back off for the last time. Most of the wood was thrown away, and a steel back fabricated of strap iron and steel rod welded and brazed together. His grandchildren may be able to use that chair.

A neighbor was in a minor automobile accident. Another car hit his rear bumper and broke the bracket at the bolt hole. This was very easily repaired by grinding the surfaces of the break clean, then clamping a large steel washer over the hole, and brazing together the entire assembly. This makes a much stronger job than just ordinary welding or brazing of the broken part.

If one may draw conclusions from the above, there are many small welding jobs to be done around every home at one time or another. The job shop welder can get this business, if he makes the people in his community "welding conscious." The people have to be conscious enough of this service to bring their repairs in just as they bring their shoes to the cobbler. Some job shop welders have successfully done this, and they have a constant stream of quarters, half dollars, and dollars coming in from small jobs which can be done in spare time between the larger jobs.

Another conclusion to be drawn from my experience in the repair of household utensils and toys is that if the manufacturers of many of these articles had taken advantage of welding in the first place, their products would have been stronger and more durable, and there would have been fewer occasions for making repairs.

The Children's Toys Broke.
(But they were welded better than new. On the porch rail above is a welded metal flower box.)

New Triborough Bridge Has "Battledeck" Floor

New York City motorists are now driving to Manhattan, Bronx or Queens over the new Triborough bridge, spanning the Harlem river between Randall's Island and Manhattan, and also crossing Ward's Island and Hell Gate to Queens.

This new structure, erected to speed up traffic movements between the three boroughs, represents the largest use of welded structural silicon steel ever recorded in bridge construction.

The flooring of the lift span units is the "battledeck" type, composed entirely of ⅝-in. structural silicon-steel plates with a 1-in. wearing surface of asphalt plank. The plates are welded together by ⅝-in. butt welds and are welded to the flanges of the longitudinal floor beams by ¼-in. butt welds. Approximately 3,000 ft. of butt welds and 1,500 ft. of fillet welds were required for laying the 350 ft. of flooring for the Bronx lift unit, the Manhattan unit requiring somewhat less.

This is one of the largest steel plate floors in existence and when finished had to be within very close limits due to the nature of the road surface. Another reason for close limits was that the steel structure supporting the floor was all completely shop assembled and reamed before erection on the job. All the riveting of the sub-stringers to floor beams was specified to be completed after the welding of the deck plates to the sub-stringers and to each other. This made it absolutely necessary to allow for and to counteract the effects of contraction and expansion, as no appreciable shrinkage of steel could be allowed without necessitating excessive field reaming on the part of the steel erector.

The butt welds were of the U-groove type. As insufficient information was available as to the amount of shrinkage to be expected in welding these long seams, it was decided by the contractor involved and the engineers in charge of the operation to complete two seams as a test, taking measurements from time to time, to observe and determine the movement of the plates. Various systems and procedure of welding were tried before test results showed the best method to be used.

Qualification of welders and inspection of work was very rigid, being at all times under the supervision of the engineers and inspectors of the Triborough Bridge Authority. Fourteen welding operators were employed on the job, and each was required to pass a break and bend test on samples welded under conditions similar to those to be encountered on the job.

The bridge deck proper can be divided for purpose of description into eight units, each unit consisting of an area with a width from the curb to the center island (half of the roadway width) and a length equal to the distance between two adjacent contraction joints comprising ten individual units of floor, and involving in the floor plate four longitudinal welds and one transverse weld.

The two outer longitudinal joints were first welded either simultaneously or in sequence. They were completely welded and allowed to cool, after which the two inner longitudinal joints were welded in sequence. Upon completion of all longitudinal welds between contraction points, the transverse seam was then welded. After completion of welding, all seams were chipped flush and ground smooth with pneumatic tools to insure

an absolutely level and smooth surface for the application of the asphalt planking which forms the finished roadway surface.

All welds were made in five passes, using the step-back method of welding, so as to keep the heat caused by the welding operation as low as possible. Each welding pass was thoroughly peened while still hot. This peening eliminated the tendency of the welds to crack on cooling and minimized the shrinkage effects usually encountered on welding of this type. It also served to remove completely the scale deposited.

The extent of the work may be realized when it is considered that the width of the roadway from railing to railing, exclusive of walkways, is approximately 70 ft. and that it is 310 ft. long from tower to tower, this being one of the largest vertical-type lift-span bridges ever built.

When the welding was started the span had been erected on car floats and was laying out in the river. A short while after this, the span was floated into position and raised into place with the welding machines on it and then raised into its highest clearance position, approximately 135 ft. above water level, where the work was completed.

In addition to the steel bridge deck, which was of course the principal item of welding, there was considerable minor welding employed in the construction of the towers, such as machinery and operating houses, grating, water-tight seams in the base of the towers, etc.

Welding was done by Smith-Hamburg-Scott, Inc., Long Island City, N. Y., for the Taylor-Fichter Steel Construction Co., of New York City, while another main welding contract was held by the Bethlehem Steel Corp. Engineers and inspectors on the job were under the supervision of the Triborough Bridge Authority and Ash, Howard, Needles & Tammen, consulting engineers on the project.

Cutting Torch Shortens Heat-Expanded Bridges

The acetylene torch came to the rescue during the recent abnormally severe heat wave, when New York City bridges, expanded to an unusual degree by the intense heat, became jammed, with resultant traffic suspensions.

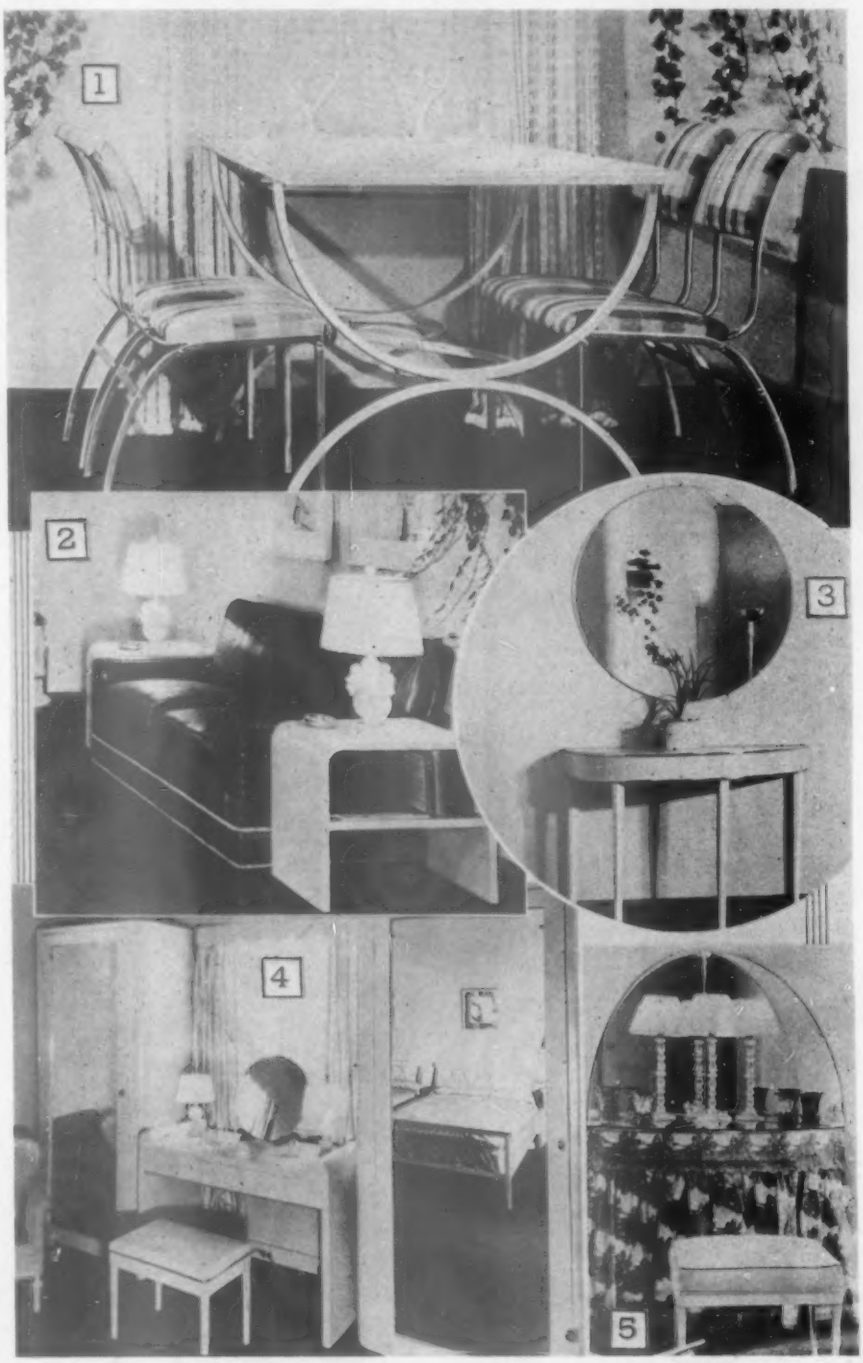
Several bridges of the turntable center-span type, constructed mostly of steel, and crossed by street railways, refused to close after opening because the maximum allowable expansion of 1½ in. between the contracting cold of winter and the expanding heat of summer had been exceeded by ½ to 1 in.

Acetylene torches were employed to cut away parts of the buffer plates at each end of the spans, after unsuccessful attempts had been made to sufficiently cool the bridges by playing streams of water on the spans, and traffic was finally resumed.

The estimated weight of boiler header piping in a power plant originally designed for cast-steel flanged fittings was 17,700 lb. By changing specifications to a flangeless welding installation, the weight was cut to 10,500 lb.—a reduction of 7,200 lb. or 40%.

Welded Furniture That the Job Shop Can Make

The job shop was called on to make some of the all-welded furniture that is cause for admiration by visitors to the arc-welded house erected in Troy, Ohio, by Hobart Bros. All that is required to produce these distinctive designs is sheet steel and an ordinary tinsmith's brake, together with equipment for welding.



Courtesy Hobart Bros.

Welded Furniture in All-Welded House at Troy, Ohio.

Fig. 1. Standard iron bar stock is easily formed and joined by arc welding to produce attractive pieces like those in this table and chair set of ornamental iron. Such sets are in demand for use on the porch or lawn as well as in the modern breakfast nook.

Fig. 2. The distinctive twin end tables and book racks at either end of this davenport are easily made by welding sheet steel.

Fig. 3. This hall table with semi-circular top is all of sheet steel, arc welded. It is finished in ivory lacquer with narrow trimming bands of stainless steel.

Fig. 4. Twin wardrobes, a dressing table and stool of arc-welded sheet steel, "arc-tailored" to fit available space in a modern bedroom. The twin beds partially shown in the mirror were built by welding in regular furniture factory production.

Fig. 5. Similar to the hall table in Fig. 3 is this dressing table, except that its top is quarter-circular to fit in the bedroom corner.

Welding Effects Great Economies in Tugboat Construction

By EDGAR P. TRASK
Gielow, Inc.

Welded Stern Post and Stern Tube.
(The tube is made up of two and three concentric thicknesses of ½-in. wrought iron plate welded together.)

AN OUTSTANDING example of the in-built stamina and the savings resulting from employment of all-welded boat construction is found in the sea-going Diesel-propelled tugboat *Resolute*, designed by Gielow, Inc., naval architects, New York City, and constructed under their supervision by the Sparling Welded Shipbuilding Corp., Astoria, Long Island, N. Y. The *Resolute*, launched this month, will be used by the owners, the Providence Steamboat Co., Providence, R. I., for towing to sea mud-laden barges from dredging operations conducted incident to the enlargement of the Cape Cod canal. The nature of this work necessarily means limited periods for lay-up and refueling, and almost continuous service; the boat's design and rugged welded construction splendidly fits it for this strenuous, exacting service.

Placing Wrought Iron Plating on Hull.
(Note the longitudinal frames which brace the vessel fore and aft.)

The *Resolute* has an overall length of 95 ft., beam of 24 ft. and draft of 12 ft. Its hull is longitudinally framed and of welded construction throughout. There are almost no structural shapes; such shapes as are used, rounds and half-rounds, constitute only approximately 11,000 lb. of the 265,000 lb. net weight of the steel and wrought-iron hull. Plates and flat bars constitute more than 90% of the total weight.

The guards or fenders usually found on each side of the hull are conspicuously absent, being replaced by an extra-thick shell. The sheer strake of ¾-in. plate affords necessary protection without any projections along the sides.

Wrought Iron Used for Outside Plating

Wrought iron is employed for the entire outside plating. While the substitution of wrought iron for mild steel may involve an increase in initial cost, a longer life is anticipated, and the reduced amount of the general stresses found in smaller craft such as the *Resolute* renders the substitution entirely practical.

Transverse strength is maintained by transverses, generally 6 ft. apart, consisting of ⅜-in. plates, 12 in. wide at the side increased to 24 in. at the bottom center and having a 6x⅜-in. face plate. The deck web is ⅜-in. plate, 10 in. deep, having a 4½x⅜-in. face plate. These transverses form solid bands about the boat. Longitudinal strength is maintained by ⅜-in. plate longitudinals of depth indicated and intercostal between webs.

The stern post, rudder and rudder frame are welded. In place of the usual cast-iron construction, the stern tube is made up of two and three concentric thicknesses of ½-in. wrought-iron plate welded together, the inner being 12 in. inside diameter. The tube is welded to the stern post and encloses a rubber bearing.

The web frames are recessed for the inner strakes of shell plating, and the outer strakes are lapped. All butts are flush. The engine is mounted on two ⅝-in. plate girders extending the full length of the engine space and cross oil bunker—more than 40% of the length of the boat. The usual fittings are found in the *Resolute*, including bitts made by welding plate and pipe.

Immediately forward of the engine room is a fuel compartment extending the full width and depth of the boat and having a capacity of 14,000 gallons. In

The Transverse Framing.
(Fabricated by the Lukenweld Co. at Coatesville, Pa., and was shipped by truck to the scene of erection.)

the engine room there is a welded 1,000-gallon fresh-water tank.

The main propulsion engine is a McIntosh & Seymour heavy-duty, 4-cycle, 6-cylinder Diesel, with 17½x25-in. cylinders, rated at 750 b.hp. at 225 r.p.m. The principal auxiliary is a generator-compressor pump unit, consisting of a 2-cylinder, 20-hp. Hill Diesel engine, direct connected at one end to a 10-kw. 125-volt generator, and at the other end through a clutch to a Northern rotary bilge and wrecking pump, of 160-g.p.m. capacity, and a Worthington air compressor of 21-cu. ft. capacity.

The steering engine, of Sentinel type, is mounted on a steel plate foundation built into the fantail below deck. A towing or spooling machine, with welded frame, is operated by a 10-hp. motor.

For heating the quarters, there is a Preferred Utilities steam boiler, of welded steel construction, in the engine room, using fuel oil drawn by gravity from the welded fuel-oil service tank.

Welded Hulls Reduce Tugboat Weights

The advances in tug-boat construction in the past fifteen or sixteen years made possible by the use of welded hulls and internal-combustion engines, are well illustrated by comparing the approximate weights of the *Resolute* and a tug of the type used in 1920, having similar dimensions, but being of riveted construction and having a 700-i.hp. reciprocating engine supplied with steam at 190-lb. pressure by a Scotch boiler, 14 ft. 0 in. in diameter and 11 ft. 0 in. long, using coal for fuel (this tug has conventional wood fenders and rail and wood pilot house):

	WEIGHT IN TONS	
	Resolute	1920 Model Tug
Steel	118	135
Other hull items and hull engineering weights	35	60
Propelling machinery	83 (750 b.hp.)	129 (700 i.hp.)
Hull and machinery, total	236 tons	324 tons
Load	47 (14,000 gal. of fuel oil)	...
	6 (1,500 gal. of fresh water)	...
	6 (Stores, etc.)	...
Total load	59 tons	...
Displacement	295 tons	324 tons
Mean Draft	10 ft. 8 in.	11 ft. 3 in.

It will be noted that on the same form the 1920-model tug will draw 7 in. more when carrying no load, than the *Resolute* will when carrying fuel for about 350 hr. of full power operation together with water and stores. Further advantages of the newer type are found in comparison of operating costs of 750-hp. steam and Diesel equipments.

Operating savings per month are estimated at slightly under $1,800. Assuming 11½ months operation per year the annual savings of Diesel over steam are more than $20,500, or about 15% of the first cost, represented by $115,000.

Completed Sea-Going Tug, 95 Ft. Long.

Further evidence of the popularity of welded boat construction is found in the fact that construction of two 100-ft. welded tugboats, designed by Gielow, Inc., was recently begun by the Russell Erie Basin Shipyard, Inc., Brooklyn, N. Y. These boats, 5 ft. longer than the *Resolute*, are equipped with water-tube boilers for supplying steam to barges alongside. The engines, also of 750 b.hp., are equipped with reduction gearing having a ratio of 5-to-1, giving a propeller speed of 120 r.p.m. This materially reduces the weight of the propelling machinery, thereby adding to the possible fuel-carrying capacity and the continuity of operations without refueling. In this design the fuel is carried in built-in welded tanks abreast the boiler.

Lettuce Harvesting Trailers Built by Welding

An unusual record was recently made in production welding by the Welded Fabricating Company, of 6009 South Wilmington Ave., Los Angeles, in the construction of 40 all-welded trailers for use in the lettuce fields of Imperial Valley, in Southern California.

Under View of Welded Trailer.

Welding contributed to several features in these trailers, which provide added economy, convenience and efficiency in their use and operation. The main beams for the frames of the trailers are of 4-in. I-beams. Cross members are of specially formed 12-gauge sheet metal, electrically welded to the I-beams 18 in. apart.

A specially designed fifth wheel of all-welded construction eliminates all side-sway of the trailer at high speed, and assures safety and smooth riding. The tongue, or hitch, made of 2-in. extra-heavy pipe with strong bars for braces, is also all-welded. Vacuum brakes are standard equipment to comply with the state highway requirements.

The bed of the trailer has a movable folding bottom, made up of wooden strips secured to a chain belt. This feature, which operates with a hand rachet mechanism operating at either end, together with sides which drop down when desired, provides a clever labor-saving conveyor-like combination for unloading, as can be noted in the illustration.

The trailer bed is 16 ft. long, 7 ft. wide and 16 in. deep, being of 12-gauge sheet metal. The trailer is built especially for use in the lettuce fields, the wheels being spaced just 42 in. apart to track properly between the produce rows.

According to the builders, about the only practical way to build these trailers (with the special features desired) was by welding. This type of construction proved most economical and was also best for withstanding the rough usage in the fields, where the trailers are subjected to considerable strain in crossing irrigating ditches, laterals, etc.

The builders state that the entire work of assembling and welding these 40 trailers was completed in 15 days, which is not a bad record for a small concern with limited working space and facilities. Heavy-coated electrode wire was used throughout.

I. A. A. to Hold Annual Meeting in St. Louis

The 37th annual convention of the International Acetylene Association will be held in St. Louis, Mo., Nov. 18 to 20. Technical sessions will be at the Jefferson Hotel. The proposed program contemplates two luncheon sessions, three afternoon sessions and two evening sessions, one being a forum and the other in the nature of a round table.

Applying LOW-ALLOY STEELS to PRESSURE-VESSEL Construction

Paper read at First Midwest Welding Conference, Chicago, June 4-6, 1936

By LOUIS J. LARSON
A. O. Smith Corporation

THOSE steels commonly known as low-alloy steels contain from a fraction of 1% to 5% or 6% of such elements as chromium, nickel, molybdenum, vanadium or copper. Among the many uses for such materials, one of the most important is pressure vessels.

Why should one use a low-alloy steel, and when? The selection of a material must always be based on economies. That does not mean that it is based on the lowest cost per pound. In addition to the cost, it is necessary to consider the physical or mechanical properties of the metal. These properties affect the life of the structure and the maintenance cost, and they may very materially affect the fabrication cost. There are many such properties, but from an engineering standpoint we will limit ourselves to a consideration of only certain ones of these.

Certain Physical Properties Deserve Consideration

Strength, as measured by the yield point and by breaking or ultimate strength, determines to a large extent the amount of material required, since it determines the cross-sectional areas. This, of course, is true in all structures which carry loads.

Ductility is another property which, while it does not enter into the equations of design, is very desirable. A ductile material will stand a certain amount of abuse and overload without failure, when under similar circumstances a brittle material might fail.

Another property which is more intangible and difficult to determine is toughness or ability to resist shock. In an attempt to measure this property, such tests as the Charpy impact test and Izod test are made. These give quantitative figures; but what to do with these figures, how to use them in design and what they actually mean, are still much-debated questions. There are eminent engineers who believe that impact strength is very important, and others, perhaps equally eminent, who say it does not mean anything. However, I believe everyone agrees that of two materials which are alike in other respects, but one has a high and the other a low impact value, the one with the high impact value is preferable, especially if the structure is to be subjected to sudden loads or shocks of any kind.

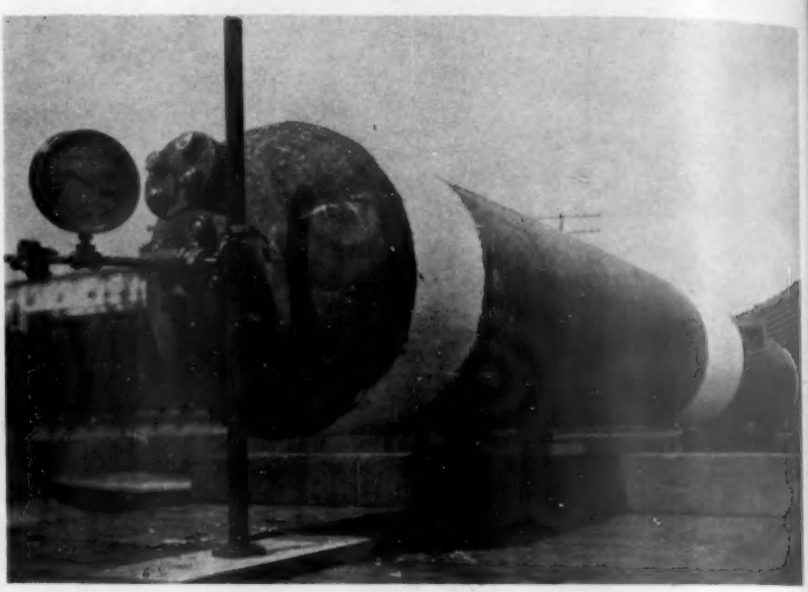
Other properties which may enter into consideration are corrosion resistance, hardness, abrasion resistance, and fatigue limit.

In certain types of service, strength becomes less important than other properties. Corrosion resistance is often a controlling factor. Certain of the chemical industries, such as the nitric-acid industry, would not be in existence today were it not for some of the stainless steels developed during recent years. In addition to the type of corrosion which eats away the material, there is also a type of chemical action which destroys its strength without reducing its thickness; by merely looking at the material you cannot tell that anything has happened to it.

Physical and corrosion-resistance properties are not the same at all temperatures. Therefore, if the equipment is to operate at elevated or at subnormal temperatures, it is quite necessary to know what the properties of the material are at those temperatures.

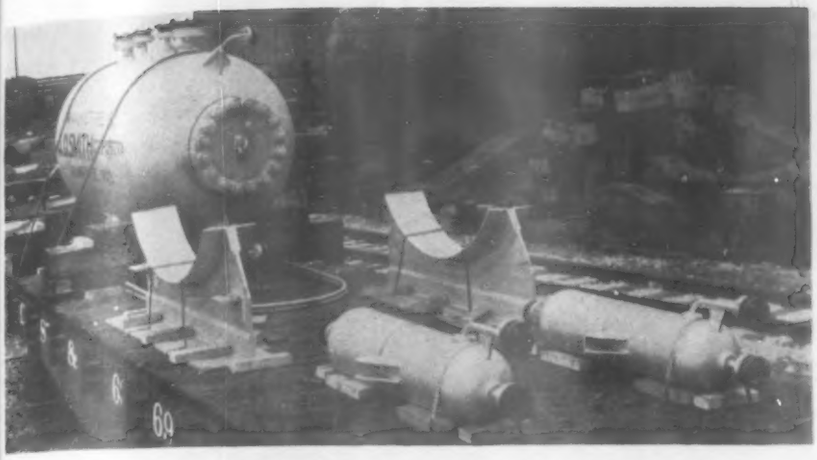
It is also important to consider some other characteristics which have a very marked effect on the cost of fabricating the structure.

In the manufacture of vessels, the plates or other parts must be formed by rolling, forging or pressing. These operations may be performed either hot or cold. Hence, the materials used must



Reaction Chamber Under Test Pressure of 10,000 Lb. per Sq. In.

(This chrome-vanadium-steel vessel was one of the first to be fabricated from one of the low-alloy steels. It was built for an operating pressure of 5,000 lb. per sq. in., and is used in chemical service. The inside diameter is only 26 in., while the wall thickness is 3½ in., and the length is 33 ft. The vessel weighs about 38,000 lb. Chrome-vanadium steel was chosen because of its ability to resist chemical deterioration, while carbon steel would become embrittled and weakened. The diameter is so small, in view of the great wall thickness, that it was not feasible to roll the material into a cylinder, so the shell of the vessel was formed of three slabs, each slab making up one-third of the cylinder and extending the full length of the vessel, thus making three longitudinal and two circular seams. Since there were no large openings in the vessel, all welding had to be done from the outside, and complete penetration obtained from the outside only. Preliminary work included the making and testing of all-weld-metal specimens and also specimens taken across the weld. After determining the type of rod to use and the procedure of handling in the shop, it was decided, because of the unusual dimensions of the vessel—that is, the great wall thickness in proportion to the diameter—to make full-scale tests. Hence, a vessel of the same type and dimensions, except that it had a length of 10 ft. instead of 33 ft., was built and tested to destruction under hydrostatic pressure. Both ends blew off simultaneously, the failure in one end occurring in the shell fairly close to the head, but not in the weld nor in the fusion zone, while at the other end the head took considerable of the cylinder with it, but none of the fracture followed through the weld itself.)



Distillate Receiver and Chemical Feed Vessels for Steam Electric Plant.

(The distillate receiver is made of chrome-vanadium steel and is designed to operate at 900° F. and 1,450 lb. per sq. in. The vessel has an inside diameter of 54 in., a wall thickness of 3 in., and is 11 ft. long and weighs 27,400 lb. At 900° F. the ultimate strength of carbon steel is reduced to about 18,000 lb. per sq. in. Hence, chrome-vanadium steel was chosen because it retains its high strength at this temperature, and therefore it was possible to reduce the wall thickness to only half that required for a carbon steel vessel.)

lend themselves to forming under such conditions.

Also, the ability to cut and shape a material is important. For example, stainless steels cannot readily be flame cut, and some of them are very difficult to machine. That has an effect on the fabricating cost of such steels. Although the low-alloy steels can be flame cut, they are more difficult to machine than carbon steel, and the fabrication cost is thus increased.

Some of the low-alloy steels fit into the picture between the carbon steels and some of the more expensive alloys. In the long run, the material that is most economical will be the one that is finally selected. That results in a compromise. The material finally decided upon is generally not the cheapest per pound that is available; neither might it be the best-known material for the purpose.

Costly Steels Often Cheapest In the Long Run

For instance, for resisting corrosion, gold, platinum and silver, and other "noble" metals would generally resist corrosion much better than the materials that are commonly used, but they are prohibitively expensive. Carbon steel will resist certain corrosion media for a time, but the replacement would be so frequent as to make the cost prohibitive. Also, the physical properties of some of the alloy steels are so high that from a strength standpoint they are the cheapest materials, even when their pound price is as much as two or three times the price of carbon steel.

Chrome-vanadium steel is used in many applications in preference to carbon steel, because of its resistance to embrittlement and its high strength at operating temperatures of the order of 900° F.

A material which has found use for equipment inside oil vessels is 4% to 6% chromium steel. This material has excellent physical properties, and it can be heat-treated to acquire very high tensile strength. But, again, this material is not selected primarily because of its physical properties, but because of its resistance to the type of corrosion which occurs in oil vessels. It is said to have a life of anywhere from three to ten times as long as carbon steel under the same service.

Extreme Care Needed in Welding Chromium Steel

Due to the fact that this steel is air-hardening—particularly so if the carbon is not very low—it must be welded with extreme care, and it must be annealed after welding. Although carbon steel may be stress-relieved to some extent by peening, one cannot relieve the hardness in chrome steel and restore its ductility without annealing. After annealing, however, the weld metal shows physical properties equal to those of the stock, and there is no difficulty in obtaining 30% elongation on the standard free-bend specimen. That is as much as is required of ordinary carbon steel, according to the various codes.

The oil companies were the first to demand material for very high-temperature service, and they were also the first to require vessels for operation at low temperatures. I think it was about three years ago that one of the oil companies required some vessels to operate at about —50° F.

Chromium is a very satisfactory material for developing strength in steel at room temperature and at elevated temperatures, but it is not the best alloy to use for low-temperature service. At low temperatures, most materials tend to have a greater strength than they have either at room temperature or at elevated temperature; but at the same time many of them also lose a certain amount of ductility and toughness. As a practical example of this, it is well known that there are many more rail failures in severely cold weather or in very cold climates than there are in mild or hot weather.

Nickel Steel Recommended for Low-Temperature Service

One company who was interested in finding a material which would be safe at —40° to —50° F. specified minimum impact or Charpy value of 15 ft.-lb. tested at —50° F. Nickel steel, containing 2.25% to 2.60% nickel was used.

After welding this material a great many tests were made both on the weld and on the plate material and on the junction and fusion line. Specimens were taken longtitudinally of the weld and across the weld; the keyhole notch was drilled vertically and horizontally; and tests were made at room temperature, at —50° and at —75° F. Some of the specimens were held at those temperatures for an hour, some of them for 24 hours,

One of 17 Nickel-Steel Vessels Built to Operate at Temperatures as Low as —50° F.

(The material in this vessel contains 2.25% to 2.60% nickel, but in other respects it corresponds to the usual analysis of ordinary carbon steel. This vessel is 54 ft. 6 in. long, 10 ft. in diameter, with a wall thickness of 1-13/32 in., and weighs 93,500 lb. The minimum tensile strength of 70,000 lb. per sq. in. specified in this case, and the Charpy impact value of 15 ft.-lb., are both higher than code requirements, but in other respects the code was rigidly followed. Many nozzles, clips and other "gadgets" had to be welded onto the vessel.)

Typical Physical Properties in Plate and Weld Metal for Steels Suitable for Vessel Construction.

King of Steel		PLATE PROPERTIES Yield Point, lb./sq. in.	Ultimate Strength, lb./sq. in.	Elongation, % in 2"	WELD PROPERTIES Yield Point, lb./sq. in.	Ultimate Strength, lb./sq. in.	Elongation, % in 2"
Carbon Steel	C Max. .20	25,000- 35,000	45,000- 55,000	40-50	40,000- 45,000	50,000- 60,000	35-45
	C .20-.30	30,000- 40,000	55,000- 70,000	30-40	45,000- 50,000	60,000- 70,000	25-35
Manganese Steel	Mn 1.0-1.5	40,000- 60,000	60,000- 90,000	25-35	50,000- 75,000	65,000- 95,000	15-30
Nickel Steels	Ni 1.0-2.0	40,000- 50,000	60,000- 70,000	40-50	45,000- 55,000	60,000- 75,000	25-35
	Ni 2.0-3.0	45,000- 60,000	70,000- 80,000	30-40	50,000- 65,000	70,000- 85,000	20-30
	Ni 3.0-3.8	45,000- 60,000	80,000-100,000	25-35	65,000- 80,000	85,000-100,000	15-20
Chrome-Vanadium Steel	Cr .80-1.10, V .15-.20	55,000- 65,000	85,000- 95,000	25-35	65,000- 80,000	85,000-100,000	15-25
Chrome Steel	Cr 16-20	40,000- 55,000	70,000- 85,000	20-40	55,000- 65,000	75,000- 90,000	15-25
Chrome-Nickel Steel	Cr 17-20, Ni 7-10	30,000- 45,000	80,000- 95,000	45-65	35,000- 50,000	70,000- 90,000	20-45

Note: The carbon content, except where specified, is not above 0.30%.

and others for 72 hours. All these tests showed that the weld had substantially the same impact value as the plate material. They also showed, incidentally, that there was not much reduction in the impact value in going from —50° to —75° F. There was no appreciable decrease in the value if the specimen was held 72 hours instead of two hours, which, of course, was important from the operating standpoint, since the vessels would be under low temperature for a considerable length of time.

The accompanying table gives physical properties of some of the low-alloy steels. In addition to those listed, there are many other low-alloy steels. New ones are being developed almost every day. Some of them have been used primarily for structural purposes, and the results are very promising. For the first time steels are being developed primarily for welding. Some of the former materials were not designed for welding and we have had to do the best we could with them. When they are handled properly they are satisfactory. However, some of the new materials which are designed primarily for welding do not depend on their carbon content for their strength, and they do not air-harden. As a consequence, welding troubles are greatly reduced.

We are just now beginning to appreciate what can be done with low-alloy steels for various constructions, and a great deal more of these steels are going to be used, especially where something else in addition to just load carrying is required. Even in those cases where strength is the prime requisite, low-alloy steels will generally be selected in spite of their higher pound price.

Good Aluminum Welding Is Found Business Booster

A wide reputation for the repair of aluminum parts has been built up by the Dobson Bros. Welding Co., of San Diego, Calif. For the past two years, this concern has used the arc almost exclusively for its aluminum work, and now the firm is branching out into the oxyacetylene welding of die castings.

"It's really surprising what can be done along this line," said J. E. Dobson, head of the company. "Not long ago a customer brought in a number of 1/16-in.-thick aluminum pitchers on which the handles had come loose at the bottom. It was only necessary to tack each of them in three places and then arc weld. Of course, if you tried to arc weld a complete break in 1/16-in. aluminum, you would likely get into grief. But the more we experiment, the finer work we are able to handle.

"Economically handled, aluminum work is among the most profitable of all types of welding, for the average owner of an expensive aluminum part is willing to pay good money for its repair. We are able to make some real profit on jobs of this kind.

"Another thing to consider is that good aluminum work is one of the best advertisements a shop can have. When a customer gets a satisfactory repair on an expensive aluminum part, he's going to remember where it was done and tell his friends about it. A lot of non-aluminum work has come to us directly through recommendations from aluminum-welding customers.

"We've done all kinds of aluminum jobs this way, but some of those on which we get the greatest volume include vacuum-cleaner handles, Packard-automobile crankcases, motorcycle crankcases, all kinds of parts for outboard motors, washing-machine parts and bakery mixing paddles. We have done all kinds of work on these bakery paddles. They seem to break easily and yet are easily repaired.

"It might be said that nearly all these items are a source of repeat business. Bakers come back for mixer work time and again. The same is true of owners of motorcycles, outboard motors and other similar items.

"We do a large volume of other work, yet we now handle about 10 per cent of the total in aluminum alone. And, it's something that's steadily building up.

"The whole secret of aluminum welding with an arc is absolute heat control. It's necessary either to go through or come very close to it. On jobs where we can't get at both sides, we do go through—but only just enough to finish the lower surface. Just a little too much heat would be disastrous.

"You pretty nearly have to learn just how much to use through individual experimentation, for every individual job constitutes a new problem. A lot is determined by the rod used, a lot more by the thickness of the metal itself.

"We've also found that machines differ a great deal. We have two of the same capacity, yet the arc of one is so much hotter than the other that we have to use it very carefully. With a 1/8-in. rod, we use 100 amperes and 20 to 30 volts on the first machine. On the second, using the same rod, we have to hold the amperage down to between 50 and 70. On the first machine, using 3/16-in. rod, we use 150 amperes and 35 volts."

Realizing that manufacturers of many items are going more and more to the use of die-cast metal as a means of saving finishing costs, this welder has also prepared himself for gas welding this type of work.

"I believe there will be lots of business in this line," say Dobson. "Every year, more and more of this metal is being used. It was impossible to weld some of the cheap die-cast stock which first came out, but now most manufacturers are turning out as good a grade of metal as possible and you can weld a lot of it.

"Even with a special rod, a lot of care is necessary in handling die castings, lest the whole piece will melt down in a pile—just like trying to weld lead. When you're welding a $20 carburetor, or some other equally costly item, you just can't let that happen. We are doing a constantly increasing volume on carburetors. Other items we weld a lot of are washing-machine parts, door handles and number plates on automobiles. The latter are often broken to pieces in wrecks."

A welded joint whose length is parallel to the direction of stress is said to resist impact much better than one at right angles.

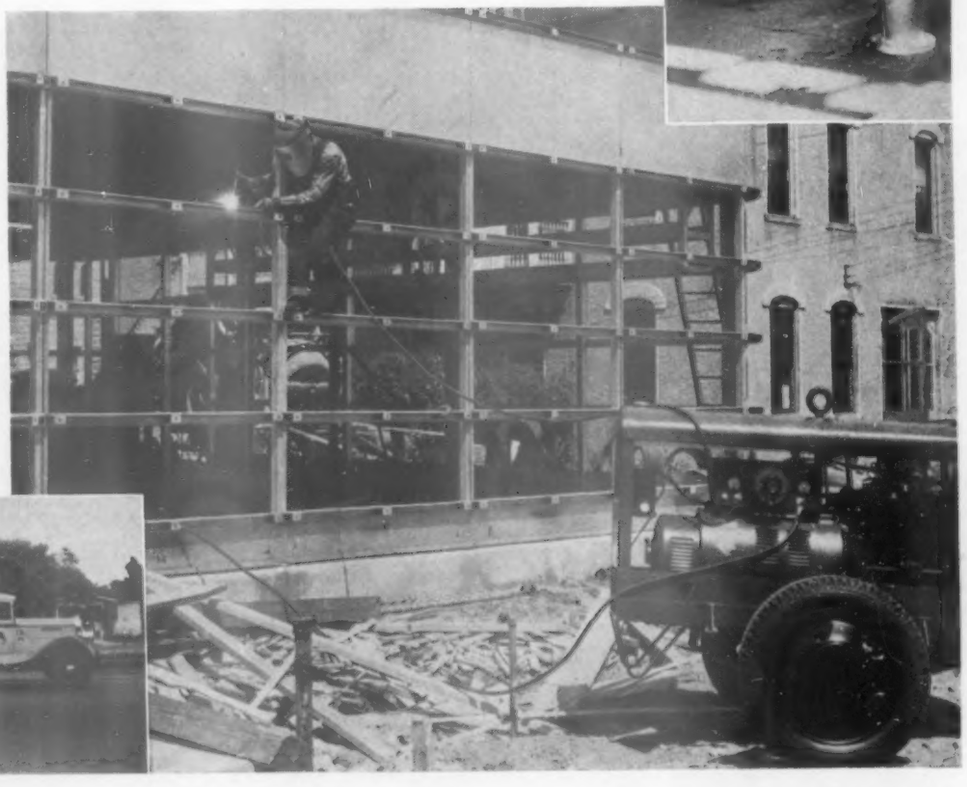
Welding News in Pictures

• Taking the "click-click" out of rail travel by building up battered rail-ends. Scene on the Lehigh Valley railroad near Slatington, Pa.

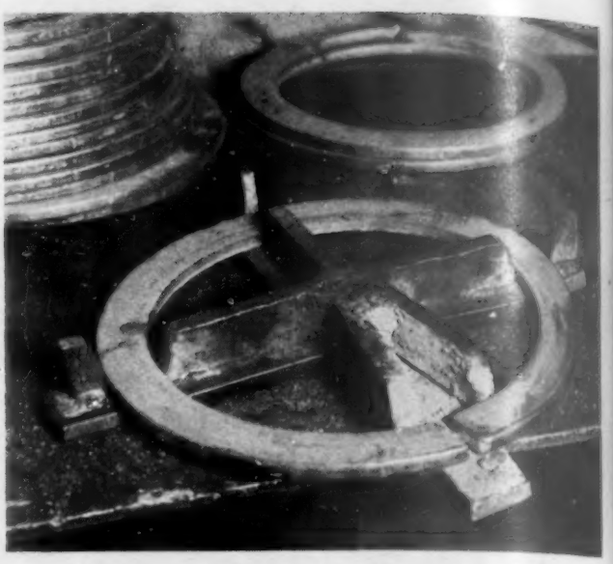
• Welded tubular steel of great strength, yet light in weight, forms the frame work of the body unit of a new type motor coach manufactured by Gar-Wood Industries, Inc., Detroit. The body unit serves both as body and chassis frame.

• This horn-shaped structure spreading out from 8 in. diameter at the bottom to 8 ft. at the top, consists of 26 pieces of 3/16-in. ingot iron welded into one integral unit. Fabricated by Farrel Mfg. Co., Joliet, Illinois. (Photograph by courtesy of The Lincoln Electric Co.)

• Attractive all-welded steel retail oil stations are being built all over the country. They are low in cost and speedy to erect. (Photograph by courtesy of Hobart Brothers Co.)



• All-welded truck trailer, eight tons capacity, has welded pressed-steel channel frame and welded fifth wheel. Built by the Slauson & Santa Fe Ave. Welding Works of Huntington Park, Calif.



No. 1. Simple Fixture Holds Motor Bearing Rings in Place While Being Welded.

Simple Fixtures Assure Correct Welding . . .

By FRED B. JACOBS

WELDING practice as carried out on a production basis in fabricating various machine parts generally can be expedited by providing simple fixtures for locating and holding the parts to form a given unit in their correct relation. In making many simple welds fixtures may not be necessary, of course; but in the majority of operations, special fixtures are recommended, as they save time and assure accuracy.

Means for accurate location of the parts to be welded and ease of operation should be given consideration in the design of welding fixtures, and in this article a few simple welding fixtures in daily use at the plant of The Lincoln Electric Co., Cleveland, Ohio, are illustrated and described.

One of the simplest welding fixtures used at the Lincoln plant is shown in Fig. 1. The part in position on the fixture is a motor-bearing-bracket ring, 15 in. in diameter, which is formed from steel bar stock, 1½x½ in., bent cold into a circle.

The ring is held in three depressions provided for the purpose. In this position the gap at the front is closed by welding. As all parts are located on the same fixture, it is obvious that the finished rings will be of the same diameter within close limits.

The part shown at the left in Fig. 2 is a motor-frame ring 19 in. in diameter and 3½ in. wide, made from ½-in. steel. The piece is cold rolled into circular shape with the joint closed by welding. The four lugs and the bracket also are welded in place. To weld this unit without a holding fixture would require considerable time and the resulting ring might not be accurate as regards the spacing of the various parts.

The simple fixture shown at the right, however, locates the parts quickly and accurately and the vertical position of the fixture expedites the welding operation. While it is true that this part could be welded in a fixture lying flat on the bench, this location would be awkward for the welder. As it is, his work is directly before him for downhand welding.

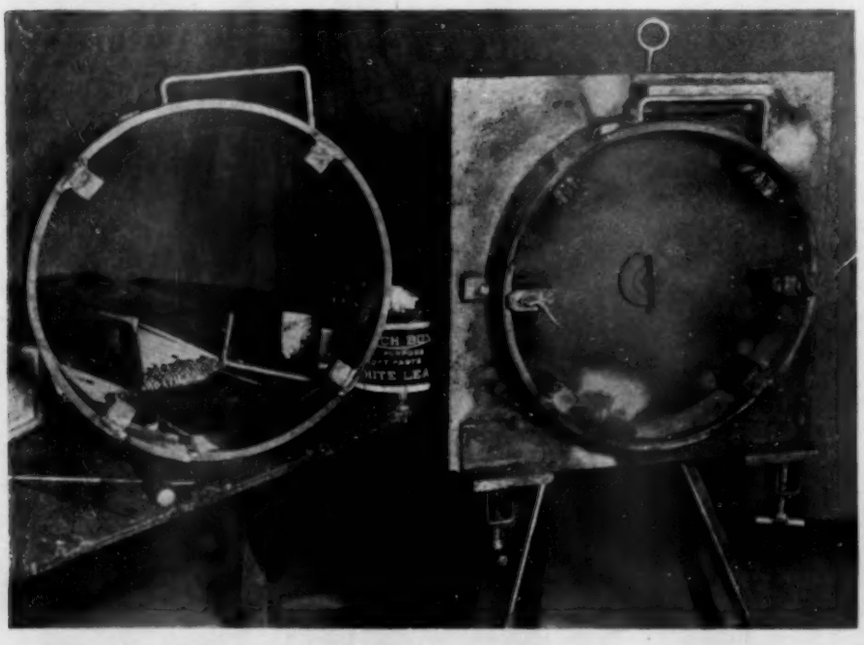


Fig. 2. Motor-Frame Ring and Holding Fixture.

(By means of this fixture, a bracket and four lugs are welded to the 19-in. motor frame ring shown at the left.)

Fixture Assures Uniformity in the Welding of Assemblies

By means of this fixture, the ring is held in place with two clamps. A bracket also is provided for the accurate location of the part at the top. Brackets also are employed for positioning the four lugs. Thus after the piece is set in place all the welds can be made one after another with the assurance that the finished units will be alike.

The heavier the part to be welded, the more substantial must be the welding fixture. The fixture shown in Fig. 3 is used for welding a 4x½-in. stock rolled into a 20-in. circle. The ring to be welded is slipped over the central locating seat, which is split and provided with a screw adjustment, as a certain amount of go and come is necessary in getting the ring in place.

With the work in place, the seat is expanded to the correct diameter. Then the two circular jaws, one at either side, come together to compress the ring to the correct diameter. These jaws are worked by a toggle-joint motion, power being derived from an air cylinder located below the fixture. This is a powerful apparatus and an excellent example of an efficient means for sizing and welding these comparatively large rings quickly and accurately.

The part shown in position in the welding jig in Fig. 4 is a welder bearing bracket 19½ in. in diameter and 7 in. high. This unit is made of two rings fastened together with four arms which are welded in place so as to form an integral unit. The upper ring slips into

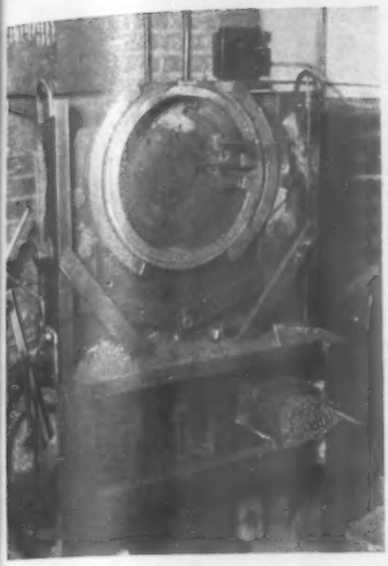


Fig. 3. Fixture for Welding a Heavy Ring.
(The ring is slipped over the central locating seat and held in place with pneumatic jaws.)

a seat in the fixture, which locates it centrally, while lugs also are provided for locating the arms 90° apart. The lower ring rests on supports provided for the purpose.

The brackets on the fixture base just back of the arms are for locating another type of bracket, as this is a double-purpose fixture. Thus with the parts in place as shown it is a simple matter to make the welds. Usually the parts are tack welded in the fixture only, the welding being completed after the bracket is removed from the fixture. This is a good example of a simple welding fixture for locating arms equidistant about a circle.

Efficient Jig Speeds Welding of Motor Frames

An efficient welding jig is used for welding the motor frame shown at the left in Fig. 5. This frame is 10 in. in diameter and 10½ in. high, and is only one of many sizes made at the Lincoln plant. The frame consists of two end rings, four tie bars, and four lugs, all of which are welded in place. The fixture can be turned about on its center to facilitate the welding operations. The four tie bars rest in slots in brackets provided for the purpose. The end rings then are slipped into position. The end plate at the right is provided with slots for locating the four bosses, while the tie rods are clamped in place as shown.

In this position it is a comparatively simple matter to make the necessary welds to form an integral unit. This operation is a good example of a welding job calling for a special welding fixture, for without the fixture unnecessary time would be consumed in locating the parts accurately.

The unit shown in place in the special fixture in Fig. 6 is a welder platform, 56 in. long, 21½ in. wide and 9 in. high, built up by welding. The fixture itself also is built up by welding and is provided with wheels to facilitate its being moved about readily. The upper part which supports the work is provided with a universal joint movement, counterweighted as shown, so that the work can be tilted in any direction the welder desires, to obtain downhand welding.

The frame is located upside down and the two uprights, which project downward when the frame is in use, are located the correct distance apart on brackets and clamped into position. The angular braces, one at each end, are located in slots provided for the purpose. The finished frame represents strong construction; but without an adequate fixture for locating the parts for welding, the cost of such a frame would be greatly increased.

In Fig. 7 is shown another very good

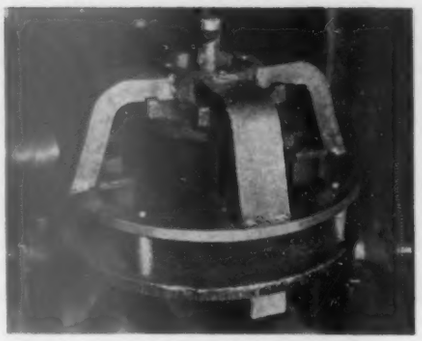


Fig. 4. Handy Jig for Tack Welding.
(On this jig is assembled a bearing bracket consisting of two rings held together by four arms.)

example of a special welding fixture. The work in place in this fixture is a sheet-metal-box assembly for a welding outfit. The box is 10x16x20 in. With the work in place as shown in Fig. 7,

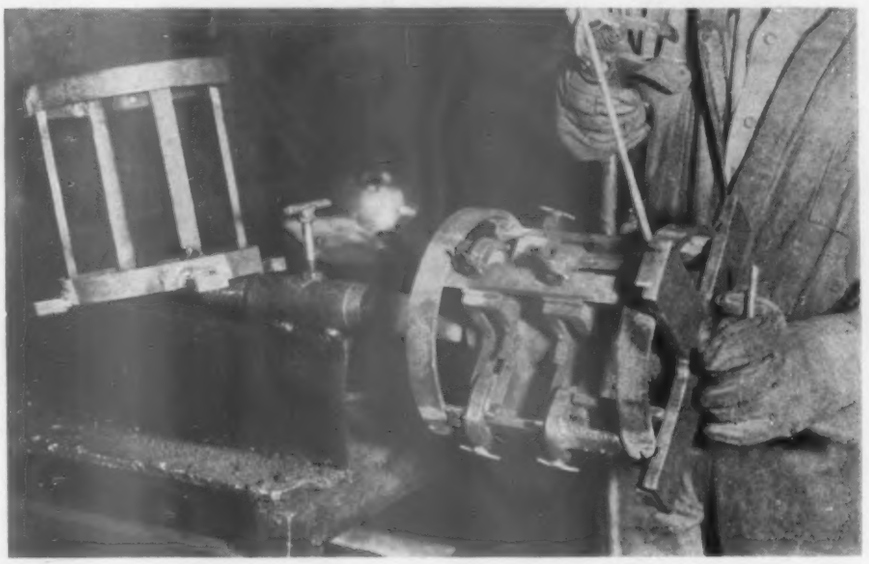


Fig. 5. Jig for Welding Frames of Motors.
(The frame at the left is welded into one unit on this jig. The jig can be turned at will or fastened in one position.)

Fig. 6. A Fixture That Cuts Costs.
(The frame shown in place on top of this counterweighted apparatus would cost far more to assemble if welded together piece by piece.)

the welder is ready to weld in the end section. This fixture is quite simple, being built up by welding in tripod form. A weighted universal movement is provided so that the operator can swing the work to any location convenient for him. The box section is clamped against a framework, as Fig. 7 shows, while the lugs which connect this frame to the universal movement are made channel-shaped, so that the end plate to be welded in place is slipped into position readily.

Special fixtures play an important part in keeping welding costs at normal, for without the use of such fixtures welding costs often might be prohibitive. In designing the welding fixtures described, the tool designing department at The Lincoln Electric Co. relies on past experience to a great extent. Thus when it is found that a fixture with a universal movement saves the welder's time, this design is incorporated into another fixture or fixtures as they are needed. The head of the welding department and of the time study department are generally consulted when new welding fixtures are to be designed, for they are in a position to point out from practical experience where certain features in welding fixtures will save time.

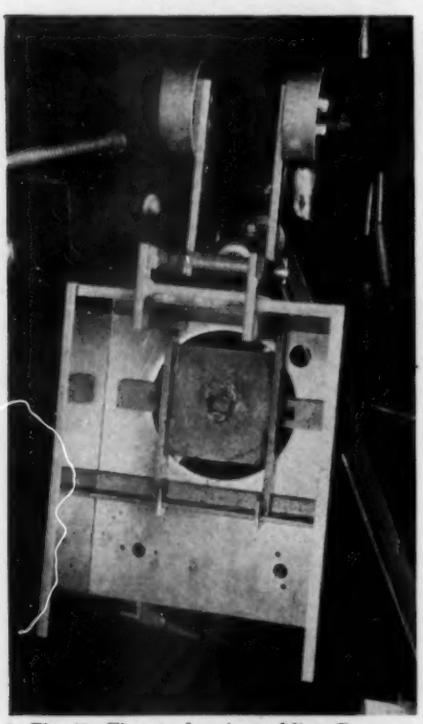


Fig. 7. Fixture for Assembling Boxes.
(This fixture spaces all parts properly, facilitating speed and ease in welding them together.)

Ten Welded Barges Launched at Midland, Pa.

One of the largest orders for welded coal barges ever to be fabricated in the Pittsburgh district, has just been completed by the Treadwell Construction Co., of Midland, Pa.

The contract called for ten all-welded steel barges for the Pittsburgh Coal Co., the equipment to be used in the transportation of coal from the huge river mines of the company.

These barges are 175 ft. long, 26 ft. wide and 10 ft. 8 in. deep. They weigh 150 tons each and have an individual capacity of 1,000 tons.

One of the Fleet of Ten 1,000-Ton Barges.

In addition to many types of welded river-harbor steel floating equipment, the Treadwell company also are large fabricators of welded steel plant and processing equipment for the chemical and other industries.

News of Welded Pipelines

The Texas Pipe Line Co. has awarded a contract for 30 miles of 6-in. pipe to be laid between Croewell and Quanah, Texas, which is to be Lindewelded, according to reports.

The Flour Corp., under their Kansas City branch office, are constructing booster stations for the Panhandle Eastern Pipeline Co. at Olpe, Haven, Greensburg and Liberal, Kan., and one also at Dumas, Texas. This work is well under way and has required a great amount of welded pipe fabrication.

The Truman-Smith Construction Co., Eldorado, Kan., have been doing a considerable amount of pipeline work this year. Work is just being completed on the 107-mile 20-in. Northern Natural Gas Co. pipeline from Hugoton to Mullinville, Kan. They are just getting a good start on their Texas-Empire work, which comprises three loops of 10 and 12-in. in Kansas, Missouri and Illinois. The bulk of their work this year has been electric welded.

The Humble Oil & Refining Co.'s 300-mile crude-oil pipeline from the East Texas field to its Baytown refinery on the Houston ship canal, has been cleaned and reconditioned as a gasoline carrier. The work involved much welding and cutting.

The White Eagle Division of the Socony-Vacuum Oil Co., Inc., has announced that it will lay a 6-in. welded pipeline from its refinery at Augusta, Kan., to Kansas City, Kan., by way of Topeka, a distance of 178 miles. The company is now calling for bids for the construction of this line. This is the fourth major pipeline project started in Kansas this year. The Continental Oil Co. is now laying a $650,000 line from Geneseo to Valley Center, Kan.; Texas-Empire has announced it will start construction of a 150-mile welded 10-in. line from Valley Center, Kan., to Sheldon, Mo., and the Northern Natural Gas Co. is at work on a $2,000,000 pipeline project in southwestern Kansas, from the Hugoton gas fields to the Panhandle Eastern line at Mullinville. All are welded lines.

The Kansas Pipe Line & Gas Co. has been granted authority by the Kansas Corporation Commission for construction of a welded gas pipeline from Rush County into Nebraska. The line will start at the gas field near Otis, and will serve a large number of towns in western Nebraska and later will be extended to serve most of the cities in northwestern Kansas.

The Shell Union Oil Corp., of California, has divided contracts for 23,719 tons of 6- to 12-in. steel pipe for a welded pipeline from Bakersfield to Martinez, Calif., among the National Tube Co., Jones & Laughlin Steel Corp., A. O. Smith Corp., Republic Steel Corp., and Spang, Chalfant & Co.

The Home Oil & Refining Co., of Great Falls, Mont., is planning to start work soon on a 100-mile 6-in. oil line from Cut Bank to Great Falls, by way of Shelby and Conrad. The line will be entirely welded. Work on the project has started.

Obtaining Sound Welds of

NEAT APPEARANCE . . .

By J. E. MINTY
General Manager,
Shaw-Box Crane & Hoist Co., Inc.

IN the manufacture of our products good appearance has been a prime requisite. This means not only pleasing design, but also smooth, concave welds of unbroken contour. In obtaining eye appeal, however, we have been careful not to sacrifice quality in materials and workmanship, and have given much attention to weld quality.

Obviously, the development of the coated rod has made possible ductile welds of high shock resistance. In our opinion, until these rods were available, any structure fabricated by arc welding was of questionable value. Accordingly, therefore, in our work we use nothing but coated rod.

Also we have found it imperative continually to consult with the manufacturers of various rods to keep up-to-date on the changes that these manufacturers make, and to take full advantage of these improvements together with the manufacturers' recommendation for the use of new developments in rods. Accordingly, therefore, we have solicited and have paid for consultation services in order that we may be informed constantly on the most up-to-date methods and rods.

"Fit the Rod to the Work." Is Formula for Best Results

In this connection, we have not only followed the recommendations of the manufacturers of both machines and rods, but have put their recommendations to the most thorough test which we could conceive in order to assure ourselves that these particular recommendations did actually, in our plant, produce the best welds and the best appearance. We have constantly striven to fit the rod to the work—in other words, use the proper rod for a particular type or kind of weld, principally with reference to the position the work is in when welding.

Again, it is obvious to all those experienced in the art that the position of the work bears probably the most important relation to the appearance as well as the quality of the weld. Hence:

First, we endeavor to make up large units in as many small assemblies as possible, so that these smaller assemblies may be properly positioned, and positioned with the greatest economy.

Second, we have provided hoisting equipment and jigs, or other means of assisting operators to quickly, and with the least amount of fatigue, properly position their work so that the molten weld will always be in a horizontal plane.

POSITIONING the work is of utmost importance in making welds of good appearance and high quality, and the savings more than compensate for the additional cost of positioning. Also, it is the author's experience that the use of structural shapes in assemblies makes for simplicity in design, ease of set-up, and saving in labor compared with assemblies fabricated entirely of plates.

Third, in order to accomplish the above most economically, we designed and built positioning machines for our particular use, and we insist that these machines be used at all times.

We have found it necessary to educate our men to the use of these machines, and further to educate them to the procedure of positioning all the work. A good, conscientious welder is always desirous of producing his work as rapidly as possible.

It took us some time to convince our operators that it was not only impossible to get a good appearance in the weld unless it was positioned, but also the quality and the physical characteristics would not be up to the standard that positioned welding would produce.

Properly Positioned Work Aids Production, Lessens Rejects

Many conscientious welders seemed to feel that the interests of the company were best served by not taking the time to properly position the work, thinking that the time saved in not positioning it was more valuable than the better appearance of the work. However, we would not consent to this, and gradually, by rigid inspection and supervision, proved to the men that their production would be increased, and rejects almost eliminated, if all the work were properly positioned. Hence, we have spared no expense to provide the facilities for positioning the work which, in our opinion, is the most important step in obtaining good physical characteristics and also in determining the final appearance, which we deem very important.

We have found that various rods produce more or less spatter. Although it is impossible to eliminate spatter entirely, by careful selection of rods we have reduced spatter materially.

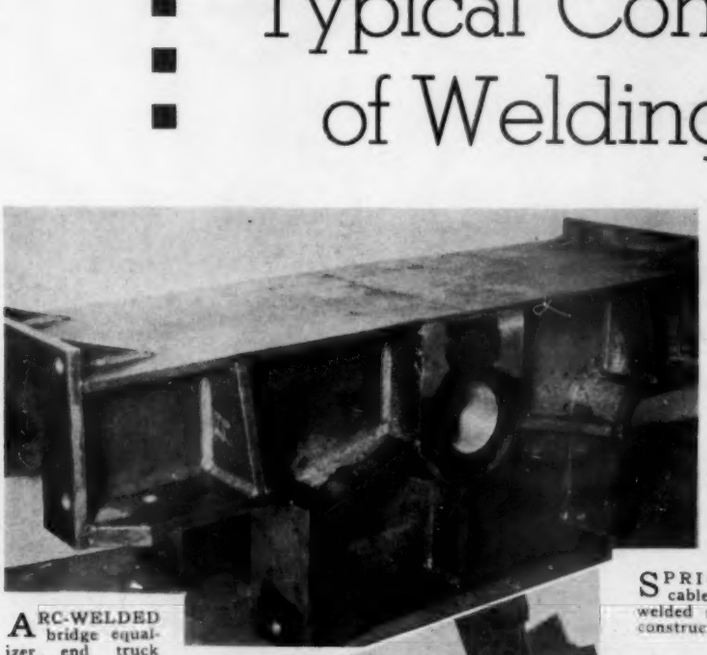
Every Welder Required to Scrape and Wire-Brush His Own Work

Each welder is required, without fail, to scrape and wire-brush his welds as he goes along, since on a complicated structure, if this is left to a lower priced man, we find much of the cleaning is omitted, and if painting occurs over such slag deposits and spatter, the final job is bound to be poor for the reason that the paint chips off with the slag and that portion of the structure is therefore exposed. Some may believe that this is more expensive than having a lower-priced man clean all the work, but in our opinion the only way that a welder may know the quality of his work is to immediately clean his weld and inspect it himself, and this also has the advantage of injecting into the welding operation about the proper amount of relaxation from the rather strenuous work of concentration on the part of the operator.

The design of the various units which we weld, such as trolley sides, truck beams, gears, etc., bears a most important relation to the appearance and quality of the final job, naturally. We have found it a distinct advantage to use shapes wherever possible, thereby eliminating the rather complicated assemblies which would result if fabricated entirely of plates.

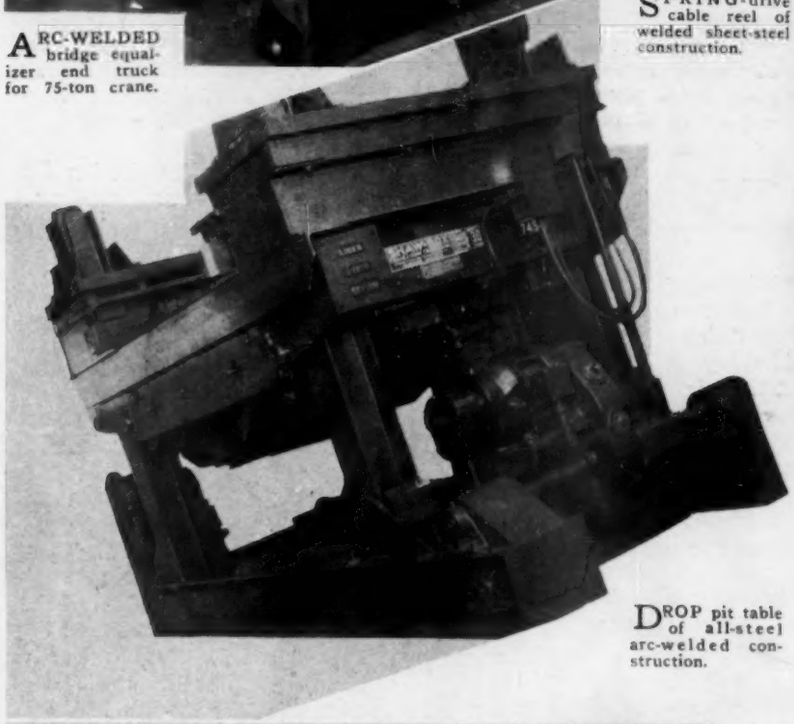
Furthermore, we find that the use of shapes enables the work to be set up much more easily, in that clamps of various sizes and types can easily be attached, and the structural material is not as costly as the labor involved in fabricating it from plate. Time saved in the tacking of the work, or its assembly

Typical Constructions That ... of Welding by the Shaw-

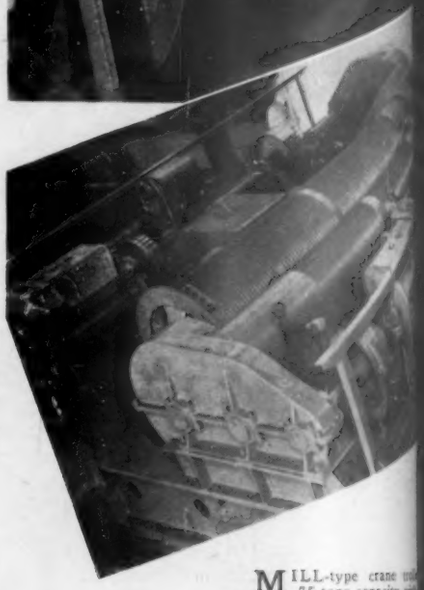


ARC-WELDED bridge equalizer end truck for 75-ton crane.

SPRING-drive cable reel of welded sheet-steel construction.

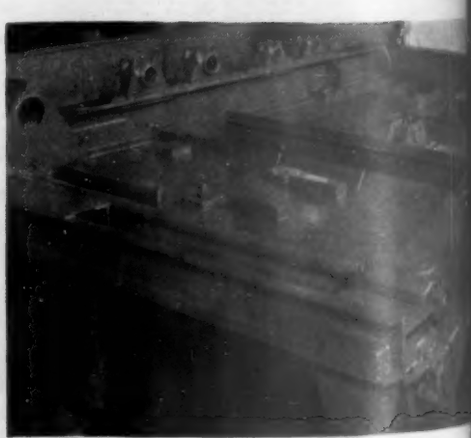


DROP pit table of all-steel arc-welded construction.



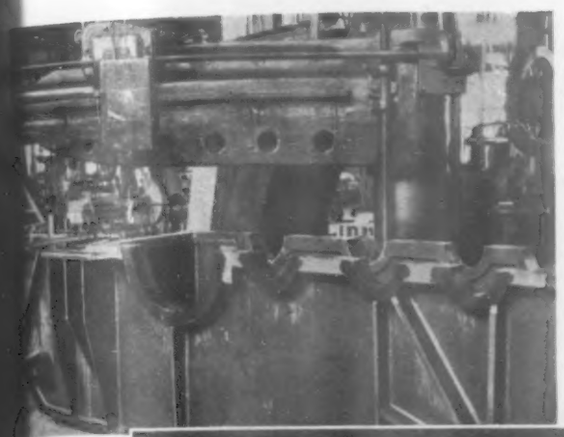
MILL-type crane ... 75-tons capacity, ... ed one-piece frame and ... gear case. Note the ... ment at bearing points.

WELDED sheet-steel gear-case covers. These are carefully machined and lapped to make them oil-tight and weather-proof.



HEAVY-duty mill-type crane trolley frame built up ... plates and arc welded into a one-piece unit. Note ... the trolley sides at bearing points, and the continuous ...

Indicate the Extensive Use Box Crane & Hoist Co.



side for
ne, with
ear case

CRANE trolley side with gear case built in. All bearing brackets and caps are flame cut from steel slabs and the brackets are rigidly welded into position and reinforced at load-carrying points.

WELDING a crane trolley side on the special positioning machine. The assembly, after clamping, can be tilted or rotated into any position

w showing assembly op-
of welded bridge end
0-ton crane. The oil pots
welded steel construction.

THIS crane, of 75-tons capacity, has welded equalizer end trucks.

UNDERSIDE view of standard trolley frame. Note method of reinforcement for machinery mounting.

for the final welding, is a saving in the final cost of the unit. In a great many cases, solely for appearance, we run a continuous bead when it is totally unnecessary as far as strength is concerned.

The resulting structure is far more rigid and superior to a riveted construction, and when properly positioned can be produced as cheaply. As an example of this, we refer to a crane end-truck, composed of two channels and a top and bottom plate. Such a member could easily be made out of four plates, but we believe the best job is obtained by the use of channels. Structural shapes used in this manner warp very little, whereas plates must be tack-welded carefully and then bead-welded continuously with great care in order to prevent a twisted and warped structure upon completion.

Up until two years ago, we made rather extensive use of low-carbon electric steel castings welded to structural members, since we found that for small and rather complicated shapes such as bearing brackets and bearing caps, castings were more economical.

Bearing Caps and Brackets Are Flame Cut From Steel Slabs

However, for the past two years we have made practically all our bearing caps and brackets from steel slabs, or billets. These various shapes, we have found, can economically be flame-cut from such material; and although the scrap loss is high, the final cost including the scrap is in no case greater than steel castings, and the pattern cost has been eliminated. Actually our savings are greater than this, in that more of the work is being done in our own plant.

Another advantage is that we are able to hold tolerances on such flame-cut members much closer than we can obtain from a rough casting, with the result that in practically no case is it necessary to take more than two cuts on a boring mill—namely, the rough cut and the finished cut—whereas frequently in the old days with steel castings which were warped to begin with, it was necessary to take more cuts and still run into the possibilities of sand spots or blow holes, which were costly on the tooling equipment, as well as the delays incurred by either welding the defects or cutting the casting out entirely and scrapping it. These losses have been completely eliminated by the use of flame-cut parts. Moreover, impurities in steel castings frequently cause very poor and porous welds, a difficulty not apt to be met with in welding rolled steel.

All the machines that we are using at present are of the direct current type. We have tried out several of the new a.c.-arc machines, both the transformer type and the motor-generator type. We believe that the a.c.-arc machine has several distinct advantages, and as and when we add to our welding equipment we anticipate using a.c. machines. The advantages of this type of arc, we find, are:

(1) It is faster.

(2) The objectionable blow-back of the arc which occurs with the d.c. machine when welding close to corners and the like, is eliminated.

(3) We find there is actually less spatter and hence less costly cleaning of the welds to produce the best appearance in the final job.

To summarize, we believe that the best results are obtained by:

(1) Carefully selecting the welding personnel.

(2) Always have work positioned.

(3) Careful and minute inspection which is continuous and not spasmodic.

(4) Maintaining constant contacts with the manufacturers of both welding machines and rods, and selecting the best rod for the purpose.

(5) Requiring each welder to produce sample welds periodically and having these tested, without permitting him to continue on production work if any of the test pieces show defects which are due to his carelessness or lack of skill.

(6) Using structural shapes rather than plain plates in the design, thereby facilitating setting up and clamping, and reducing warpage. Obviously the use of such shapes should be limited to those cases where the section requirements are economically met by their use. In other words, care must be taken that too much weight is not designed into a unit solely for the purpose of ease of setup, etc., since obviously there is a limit to which this can be carried.

(7) The use of heavier or thicker plates for diagonals, braces, etc., rather than thin $\frac{5}{16}$-in. or $\frac{1}{4}$-in. plates, since this type of member greatly improves the appearance of the design, and likewise the weld itself.

Tentative Program for A. W. S. Fall Meeting

The annual fall meeting of the American Welding Society will be held at Cleveland, Ohio, Oct. 19 to 23, concurrently with the National Metal Exposition. The Society headquarters will be at the Hotel Cleveland, where all technical sessions and committee meetings will be held, and the exposition will be held in the Cleveland Public Auditorium. The following tentative program has been announced by the Society:

MONDAY, OCTOBER 19th

9:45 a. m. Ball Room—Business Session. President J. J. Crowe, presiding.
Report on society activities by President Crowe.
Tellers' report on election of officers.
Award of Samuel Wylie Miller Memorial Medal.
Review of committee and section activities by chairmen.
Discussion.

2:00 a. m. Ball Room—Technical Session. Chairman, A. E. Gibson, The Wellman Engineering Co. Vice-Chairman, E. Vom Steeg, General Electric Co.
Welcome address by local official.
"Fundamentals of Metallurgy of Welding," E. S. Davenport and Dr. R. H. Aborn, United States Steel Corp.
"Multi-Layer Oxyacetylene Pipe Welding," R. M. Rooke, F. C. Saacke and A. N. Gugler, Air Reduction Sales Co.
High-speed motion pictures of various welding processes, E. Vom Steeg, General Electric Co., and W. E. Crawford and Walter Richter, A. O. Smith Corp.

6:30 p.m. Parlor—Dinner and meeting, Board of Directors.
Review of Society Activities, appointment of committees and officers, new business.

TUESDAY, OCTOBER 20th

9:45 a. m. Ball Room—Technical Session. "Fundamental Research in Welding." Chairman, H. M. Boylston, Case School of Applied Science. Vice-Chairman, E. R. Fish, The Hartford Steam Boiler Inspection & Insurance Co.
"Heating by the Proximity Effect," Edward Bennett, The University of Wisconsin.
"The Welding of Copper," A. P. Young, Michigan College of Mining and Technology.
"Non-Destructive Testing of Welds," W. B. Kouwenhoven, The Johns Hopkins University.
"Impact Tests of Welds at Low Temperatures," Otto Henry, Brooklyn Polytechnic Institute.

2:00 p. m. Ball Room—Technical Session. "Fundamental Research of Welding." Chairman, H. W. Gillett, Battelle Memorial Institute. Vice-Chairman, R. E. Kinkead, Consulting Engineer.
"X-Ray Methods for Studying Stress Relief," John T. Norton, Massachusetts Institute of Technology.
"Welded Beam-Column Connections," Inge Lyse, Fritz Engineering Laboratory, Lehigh University.
"Circuit Characteristics and Arc Stability," S. C. Osborne, Wilson Welder & Metals Co., Inc.
"Welded Structural Brackets," C. D. Jensen, Lehigh University.

7:30 p. m. Conference and Meeting of Fundamental Research Committee, Bureau of Welding Research and Engineering Foundation. Chairman, H. M. Hobart, General Electric Co.

WEDNESDAY, OCTOBER 21st

9:45 a. m. Ball Room—Technical Session. Chairman, A. F. Davis, The Lincoln Electric Co. Vice-Chairman, C. A. McCune, Magnaflux Corp.
"Brazing with Silver Solders," Robert H. Lesch, Handy & Harman.
"Importance of Design Control for Welded Piping Systems," T. W. Greene, The Linde Air Products Co.
"Principles of Surfacing by Welding," E. W. P. Smith, The Lincoln Electric Co.
"Technique for Resistance Welding Ferrous and Non-Ferrous Sheet Metals," E. I. Larsen, P. R. Mallory Co.

2:00 p. m. Ball Room—Technical Session. Chairman, Hugh H. Dyar, The Linde Air Products Co. Vice-Chairman, J. B. Tinnon, Metal & Thermit Corp.
"Procedures for Control of Welding Parts," G. H. Moore, Jr., Newport News Shipbuilding & Dry Dock Co.
"Welding Copper and Its Alloys—A Review of the Literature," Ira T. Hook, American Brass Co.
"Resistance Welding of Dissimilar Metals," R. T. Gillette, General Electric Co.
"Thermit Welding," J. H. Deppeler, Metal & Thermit Corp.
"The Exploration of the Modern Metallic Arc," L. J. Larson, A. O. Smith Corp.

THURSDAY, OCTOBER 22nd

9:45 a. m. Joint Session. American Welding Society with American Society of Mechanical Engineers. Chairman, C. W. Obert, Union Carbide & Carbon Research Laboratories. Vice-Chairman, Milton Male, United States Steel Corp.
"Stress Analysis," C. H. Jennings, Westinghouse Electric & Manufacturing Co.
"Alloy Steels and Their Weldability," A. B. Kinzel, Union Carbide & Carbon Research Laboratories.

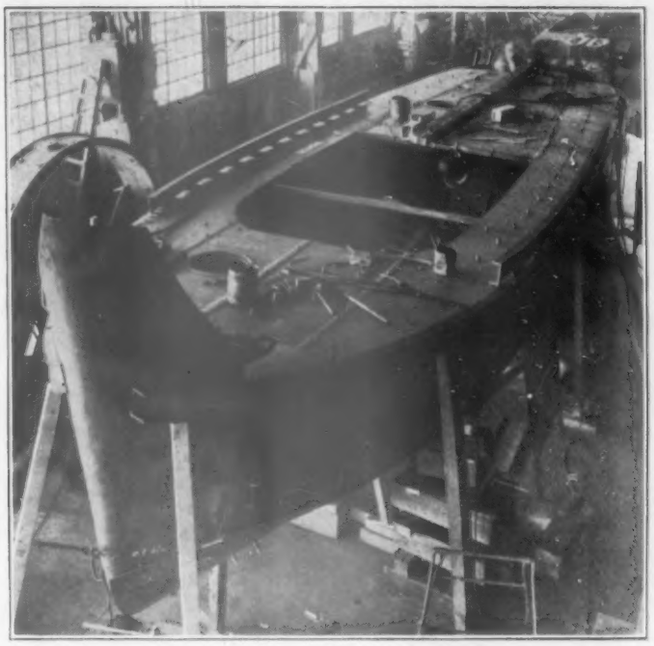
2:00 p. m. Joint Session. American Welding Society with American Society of Mechanical Engineers. Chairman, H. F. Henriques, Air Reduction Sales Co. Vice-Chairman, S. M. Weckstein, Timken Roller Bearing Co.
"Welding Heavy Machinery and Equipment," C. A. Wills and F. L. Lindemuth, Wm. B. Pollock Co.
"Steel Plate Construction."
"Using Steel Plates for Machine Frames."

7:00 p. m. Dinner dance with entertainment.

FRIDAY, OCTOBER 23rd

Morning Session. American Society of Mechanical Engineers meeting. (American Welding Society members invited.)
Weldability of Non-Ferrous Metals. Copper, Brass and Bronze, Monel Metal, Aluminum.

Afternoon Session. American Society of Mechanical Engineers meeting. (American Welding Society members invited.)
Review of Welding Development as They Affect Mechanical Design.
Welding of Light Machines and Products.
Principles Involved in Selecting Casting vs. Welding.



Bow View, Showing Prow Made of Single Sheet of Formed Steel

New Type Tugboat Economically Built by Welding

By HENRY W. YOUNG

WELDING has made possible the economical construction of a radically new type of tugboat. The first is already completed in the shops of the Commercial Iron Works, Portland, Ore., built for upper-river work by the Crown-Willamette Paper Co. Others will probably be built for operation above the Bonneville dam, now well on toward completion.

The new boat is a "pony" tug, 40 ft. long, with a 13-ft. 6-in. beam and 3-ft. 6-in. draft, powered by an Atlas-Imperial 110-hp. Diesel engine. The whole boat with power equipment and superstructure welded on will be loaded on trucks and transported to the river. The weight will be about 35 tons. There will not be a rivet in the completed frame and hull.

The new feature lies in what is called the "tunnel" design. Inspection of the photograph of the stern shows that the bottom of the boat, instead of having the usual keel, is deeply recessed at this point for a distance forward approximately one-third the length of the hull. In this tunnel the main rudder and the monkey rudder will be mounted.

This construction eliminates the complicated hull curves at the stern, which call for innumerable shapes in building the ordinary boat. It will be seen that the craft resembles the ordinary flat-bottomed boat. The bow is one solid piece of formed sheet steel, and back of that the sides are made wholly of large pieces of sheet steel, ranging from 4x16 ft. to 4x4 ft. These are ¼ in. thick, except for the bow and first strake, which are ½ in. There is an 8x3-in. channel-iron guard all around.

The bottom of the boat and the interior of the tunnel recess are constructed of large sections of sheet which at no point are more than slightly curved.

In construction all the sheeting for sides and bottom was temporarily bolted to the welded steel frame, with comparatively few bolts—just sufficient to hold the sheets together with edges abutting. All the seams were arc welded, then the bolts were removed and the holes welded up. It is estimated that had riveting been employed instead of welding, the cost of this part of the work would have been at least twice as much.

Stern Tunnel Eliminates Complicated Curves.
(The stern and the tunnel roof were welded of large sections of sheet, which at no point were more than slightly curved.)

$30,000,000 Expansion Will Utilize Welded Products

The Jones & Laughlin Steel Corporation of Pittsburgh, Pa., will use a large number of welded products in the $30,000,000 general expansion program recently authorized by the board of directors.

The plan calls for a new strip sheet mill in the Hazelwood district of Pittsburgh, and already the corporation has awarded contracts for 22 cranes, which will be equipped with all-welded trolley frames and bridge trucks.

The order for furnishing this equipment has been divided among the Morgan Engineering Company and the Alliance Engineering Company, both of Alliance, Ohio; the Cleveland Crane and Engineering Company of Cleveland, Ohio, and the Shaw-Box Crane Company of Muskegon, Michigan.

The Jones & Laughlin Steel Corporation are also large fabricators of welded equipment, manufacturing such large articles as barges, tanks, etc.

Comparative Economies *of* Metal Electrodes . . .

I—Test Procedure

By KARL MELLER

In this series of articles Mr. Meller describes tests made with bare and covered electrodes for the purpose of determining the effect of various factors on the economies of arc welding. The second installment of this series will treat of bare electrodes, and the third or concluding installment will deal with covered electrodes. Mr. Meller has contributed many articles to German technical publications and is author of several books on welding, printed in German.

AN OPINION pronounced on a technical subject embodies, after all, the summarized results of a number of individual observations. The greater the number of observations, the more difficult it is to carry them out, and the harder it is to arrive at an objective judgment of the results. If these observations are not conducted with sufficient care one is apt to reach wrong conclusions.

If too much stress is laid on certain factors, while others are unduly neglected, we obtain a subjective opinion. Considering some of the factors involved, without thoroughly testing them, will lead to a superficial opinion. If this is borne in mind, it will be quite clear why the judging of arc-welding electrodes is so very difficult and why there exist so many varying and contradictory views. Now, what observations should form the basis of evaluating an electrode?

The cardinal points are shown in Fig. 1 (diagram in the upper right-hand corner). In the first place, it is possible to check the nature of the electrode. The appearance can be checked easiest; but judging an electrode merely by such a method is by no means permissible, as it would not correspond with our present knowledge of welding. The chemical composition will perhaps offer a better chance approximately to judge the qualities of the weld.

A further examination would cover the behavior of an electrode during welding and this, of course, can be determined only by practical application. Nowadays, the most important tests pertain to the physical and chemical properties of the welded joint.

Especially difficult is it to form an opinion on the cost of a welded joint. Since even in practice it is not generally known what is the deciding factor for ensuring best economic results, it is intended to show in the following what bearing the selection of electrodes is likely to have on the cost of the welded joint.

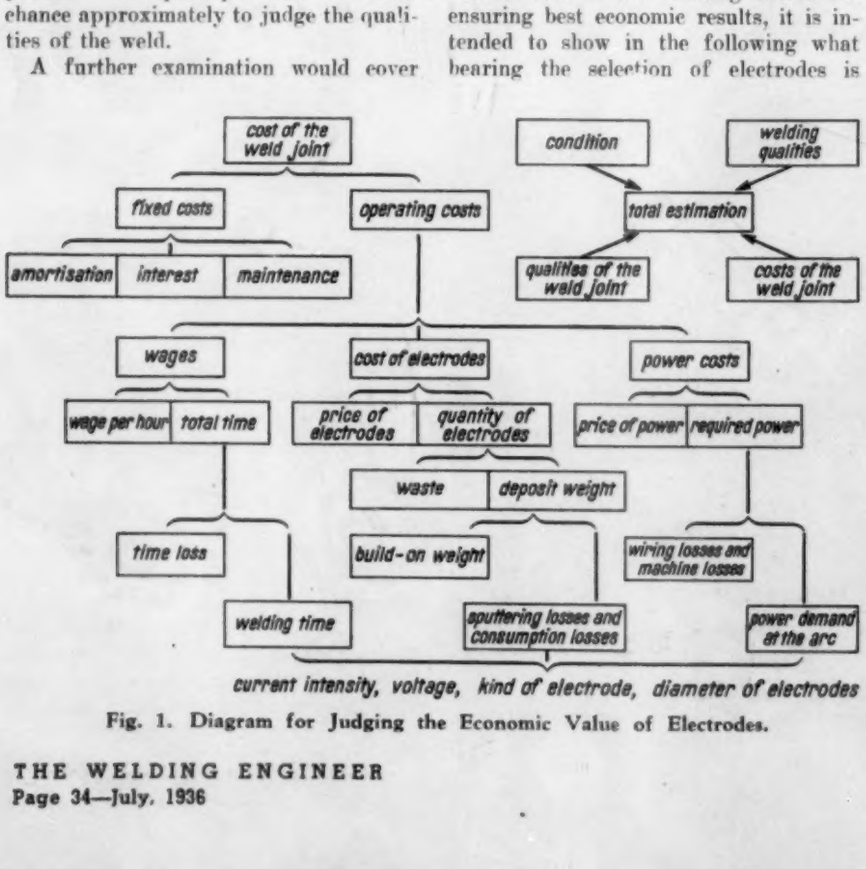


Fig. 1. Diagram for Judging the Economic Value of Electrodes.

Influence of Various Factors on Welding Costs

Fig. 1 shows schematically how selection of electrodes influences welding costs. There are, to start with, fixed costs as distinct from operating costs. The fixed costs, comprising mainly amortization, interest and maintenance, may be disregarded here, since they play but a minor part in their relation to the other costs of welding. Operating costs, however, are much more important, these being made up of wages, the cost of used electrodes, and power cost.

Of the three items comprising operating costs, the cost of labor and electrodes has a decided bearing on the problem. The former is determined by the wage per hour and the total time for making a unit length of weld seam or depositing a unit weight of weld metal. The total time is made up of the welding time and the time lost. The welding time is not a constant quantity, but is materially affected by the voltage, current, and type and diameter of the electrodes.

The cost of electrodes is determined by their price and the quantity consumed, this quantity being composed of the weight of the molten electrode metal plus waste. The molten electrode metal is composed of the deposited metal and losses due to spattering and vaporization, which may be influenced by the strength of the current and voltage, and the type and diameter of the electrodes.

The power cost is the cost per kilowatt-hour, multiplied by the power requirement, the latter being made up of the power demand at the arc and the losses occurring in the welding plant, including line and contact losses. In this case also, it may be assumed that power consumption will be affected by the voltage, current, and type and diameter of the electrodes.

In calculating the cost of welding it is important, therefore, to determine by measurements the welding time, losses due to spattering and vaporization, and the power demand at the arc, in relation to the strength of the current, the voltage and the kind and diameter of the electrodes. The term voltage covers in this case not only the amount of voltage at the arc, but also the polarity.

On the basis of these considerations, a large number of measurements were made in the following manner:

Bare and Covered Electrodes Tested in Automatic Welding Heads

Bare and covered electrodes were examined. Both were welded by automatic welding machines to obtain as constant conditions as possible. The bare electrodes were melted in such a manner that the distance of the arc from the nozzle of the automatic welding machine was maintained constant during the tests. The covered electrodes were in rod shape, having an average length of 450 mm. (17.7 in.), with current supplied through a clamp at the end. Plates having a thickness of 10 mm. (0.4 in.) were used, and the weld bead, in all but a few cases, was deposited onto the plate.

The following measurements were made: (1) weight of electrode melted, (2) deposited weight, (3) current, (4) voltage, (5) power consumption, and (6) welding time.

The weight of electrode melted was determined by weighing the electrodes prior to welding and subtracting therefrom the portion remaining after welding.

The deposited weight was determined by weighing the plate before and after the test; the spatterings found on the plate, apart from the bead, having been removed as carefully as possible. Similarly, when using covered electrodes, the slag was removed. Scraping off the spatterings results in a certain inaccuracy when determining the weight of deposit or the spattering losses, since it is somewhat difficult, on the one hand, completely to remove such spatterings, and, on the other hand, dislodge them in such a manner as to avoid removing some of the plate material. Several measurements were taken at almost every point for the purpose of offsetting such inaccuracies.

The electrical data—in particular, current and voltage—were obtained by means of precision instruments. While it is easy enough to measure the current, considerable difficulties were encountered in determining the voltage of the arc, since the voltage cannot be measured directly at the arc, but at best at the supply terminal of the wire, in the case of the bare electrode, or at the point of contact, in the case of the covered electrode. Hence, allowance must be made in either case for the voltage drop in the wire to the arc. With bare wire, this value will remain practically unchanged after the lapse of a certain adjusting time, but it will vary with covered wire according to the length and temperature. This made it necessary to compute the arc voltage from the measured values, taking recourse to special preliminary tests for determining the voltage drop in the electrode.

A further difficulty cropped up, inasmuch as the voltage, as measured by the voltmeter and maintained constant by the automatic welding machine, does not correspond to the actual arc voltage, but rather it measures the mean value of the arc voltage and the voltage obtaining during short-circuit (passage of drops). A number of oscillograms were taken with varying arc lengths to obtain the numerical value of this factor.

Power consumption was measured by a watt-hour meter, whose voltage coil was connected at the same place as the voltmeter, so that, when calculating the arc power, allowance must also be made for the voltage drop.

Welding time and welding speed were ascertained in the usual manner by a stop watch and by measuring the length of seam covered.

As an interdependence of voltage, current strength, and type and diameter of electrodes was assumed, the main tests were carried out in the following manner:

The principal tests dealt with electrodes of 4-mm. (0.157-in.) diameter. Also, bare electrodes having a diameter of 3 and 5 mm. (0.118 and 0.197 in.), and covered electrodes with a diameter of 6 and 8 mm. (0.236 and 0.315 in.) were also tested for determining the influence of the diameter.

Constant Voltage and Varying Current Employed in Most Tests

For each electrode a number of tests were made with as constant a voltage as possible, and extending over a wide range of current, so as to eliminate accidental errors and obtain a conception of the law of the curve. Sections and etchings were made for studying the shape of the welds and the amount of penetration. Other tests were made with a constant average current, extending over a wide range of voltage to determine the influence of voltage, and in this case also etchings were prepared and oscillograms taken. More than 200 individual measurements were made.

Prior to making such measurements, investigations were made as to what had already been published on the subject. The only complete work had been written by Lefring[1], and the conclusions to be drawn therefrom, in so far as they lend themselves to comparison, show general conformity with our tests.

Similarly, measurements were made by Sandelowsky[2] which, however, were limited to bare electrodes.

(To be continued)

[1] "Einfluss der Schweisstrombedingungen bei der elektrischen Lichtbogenschweissung von weichem Flusstahl," *Forschungsarbeiten auf dem Gebiet des Ingenieurwesens*, part 33, 1930.

[2] "Die Untersuchung von Elektroden für die Lichtbogenschweissung," *Elektroschweissung*, 1931, page 28 and following.

These Welders Believe In Signs

In Los Angeles are two welders who believe in signs. Both have learned that unusual signs are followed by sales of their services to prospects whose attention may be drawn by "sign language."

Charles A. Jensen increased his garage services approximately 25% when he introduced an unusual sign method to sell that class of service. The sign consists of a motor block attached to the running board of the car used in soliciting garage work. A large sign informs the interested: "This block has been run 80,000 miles by the Lincoln Stage Lines after welding by Chas. A. Jensen." Arrows are painted in large white strips on the block, pointing out the welds and how they have held.

The block and sign are a convincing proof when run into a prospective customer's garage during solicitation. Numerous letters from satisfied customers are carried in the solicitation car. When not in service the solicitation car is parked in front of the establishment, showing off the block to passersby.

A car-sign is also effectively utilized by the Williamson Welding Works. This firm uses an old-time Reo which is always parked in or near the door. The old model draws attention and large signs hung at various points on the old car serve to establish the location of Williamson Welding Works in the minds of passersby. In both these instances it may be seen that there is a definite attention factor associated with sign merchandising as practiced by these welders. This same thought is carried forward in another large sign used by the Williamson organization. This sets forth the firm's motto which is: "We weld anything from a broken heart to an icicle." The attention factor in this sign is carried forward by use of a large red heart and a large white icicle at either end of a wall banner extending across the rear of the establishment where it may be seen by all customers coming into the works. Both heart and icicle are cracked open. Bright colors are used in the lettering of the slogan.

First All-Welded Fishing Tug

What is said to be the first all-welded steel fishing tug was recently completed by the Erie Concrete & Steel Supply Co., of Erie, Pa. The vessel is 55 ft. long, with a 15-ft. beam and a 9-ft. depth of hold from deck to keel. It was fabricated of 3/16-in. Toncan Iron sheets. This type of construction was developed to provide stronger and more reliable vessels for the Great Lakes fishing fleets. According to W. E. McCain, president of the fabricating company, more boats of this type will be built.

Reducing *Wear* and *Corrosion* by SURFACE TREATMENT . . .

By MILES C. SMITH
Colmonoy Company

SINCE the idea of hard-facing or welding on a layer of abrasive-resistant or corrosive-resistant metal was first introduced, there have been repeated attempts to perfect a material which would produce the desired hard surface, stay in place and not materially increase the thickness of the metal processed.

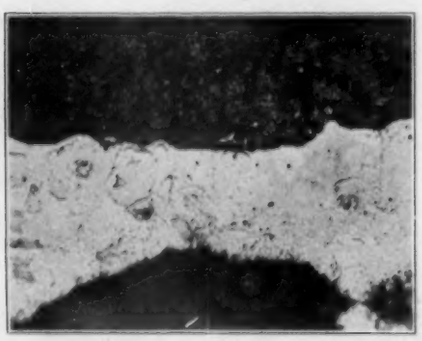
Various attempts have been made to utilize tungsten-carbide powder, boron-carbide powder and other similar hard substances, but to date the results obtained seem to have been not altogether satisfactory, and for the most part such materials have found only a very limited use.

With this same object in mind, Norman W. Cole, who has been identified as a metallurgist in hard-facing development since its earliest days, some time ago devised a method of commercially manufacturing a heretofore unknown metallic boride crystal which proved to be diamond-hard, non-oxidizing, impervious to acid action and to have such a high melting point that even the heat of the electric arc did not fuse it.

Low-Melting-Point Metallic Boride Crystal Forms Excellent Matrix

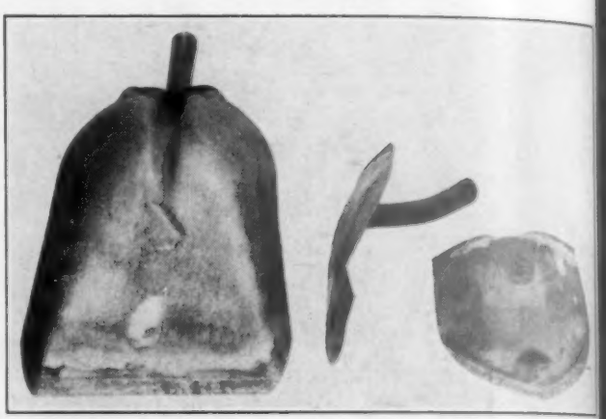
This particular type of crystal appeared to him to answer the problem insofar as a wear-resistant, corrosive-resistant substance was concerned, but it did not solve the problem of application.

Further research and experiment demonstrated that this new metallic boride crystal could be produced in a mixture of metallic boride crystals of relatively low melting point and that if this mixture be sweat into the surface of iron or steel, the low-melting-point borides alloyed with the base material to form a suitable matrix for the harder crystals.



Section Through Application of Metallic Boride Mixture.

(The diamond-hard, non-oxidizing crystals are easily discernible in the overlay mass. Magnification, 400 times, then reduced one-half in reproduction.)



Tools Treated on Wearing Edges.

(The two shovels and the scoop have had the crystalline mixture applied where they wear quickest. Middle view shows there has been no material increase in thickness by processing.)

The next step was to devise and develop application methods for this crystalline mixture which would be economical and applicable to all branches of industry, and to thin and thick sections alike.

Actual tests over a period of years have proved that this material, when sweat into the surface or skin of iron or steel, prepares those metals so they will resist abrasion, corrosion, oxidation or heat. Yet this skin preparation is not a continuous layer, will not crack off, and does not interfere with forming or forging the metal treated. Furthermore, it does not materially increase the thickness.

Of late, experiments have been going on to determine the actual temperature at which this crystalline mixture fuses with the skin of the metal processed, so that the welder or operator may be governed accordingly, regardless of the heat agency used to complete such a processing.

It was found that if too much heat or too long an exposure to heat is applied, the interalloying between the lower-melting-point borides and the parent metal takes place to too great a depth; the alloying is too complete and the skin protection effect is not produced.

Using a controlled atmosphere (that is, a non-oxidizing atmosphere) in a furnace chamber, it was found that from 2240° to 2260° F. was necessary for a perfect application. That is, when the parent ferrous metal which had been coated with the crystalline mixture, held in place with sodium silicate, was exposed to heat until it reached that temperature and was then withdrawn, the skin-fusing was completed, and the resultant overlay was the ideal one.

In order to reproduce a heating to this temperature with the oxyacetylene torch or the carbon arc, it was found necessary for the operator to move the heating agency over the work at a speed in proportion to its relative rapidity of heating, or to increase the thickness of the crystalline layer to such extent that it would partially diffuse some of the heat.

Treatment Can Be Given to Any Shape or Contour

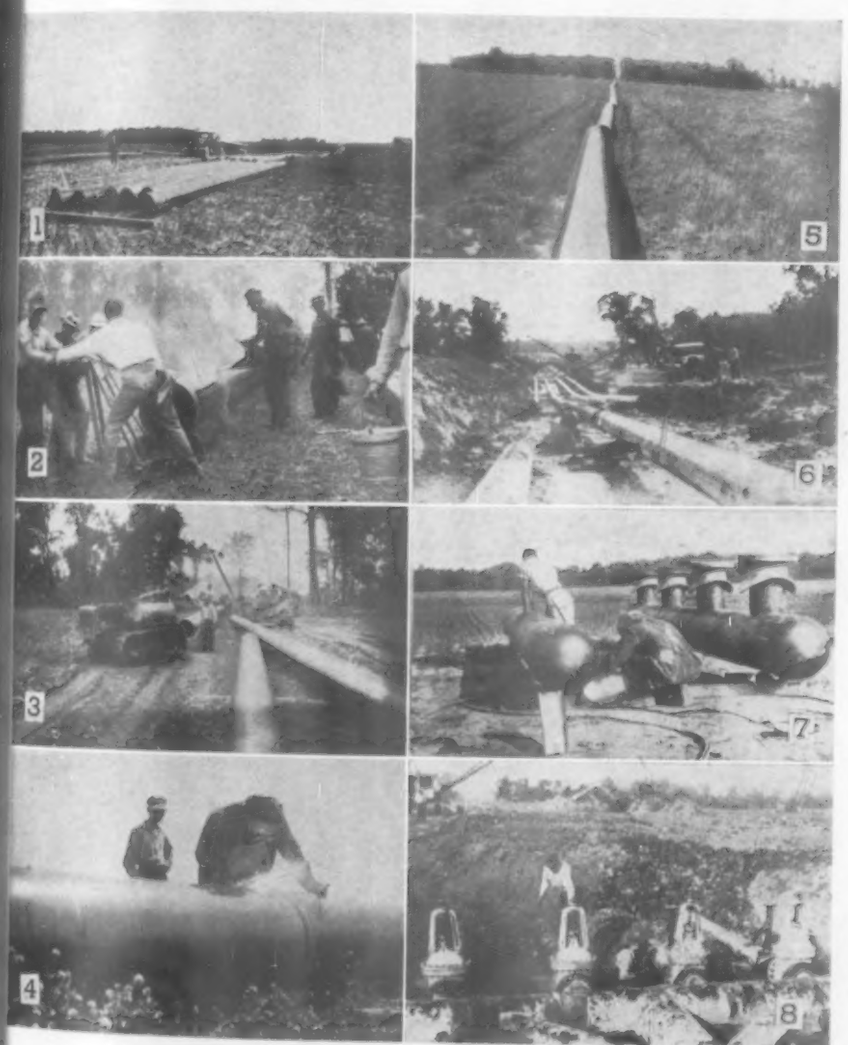
To point out the advantages of such a skin treatment over the usual method of covering parent metal with a relatively thick layer of welding electrode deposit seems unnecessary. Such a treatment is applicable to both thick and thin sections, and it can be made to follow contours or may be applied to vertical or overhead as well as horizontal planes. The disadvantages, if they be such, consist largely in the fact that such an overlay cannot be ground to polished smoothness; and that if applied to very soft steel and subjected to continued heavy pounding, the overlay will have a

tendency to imbed itself in the soft steel body, unless the parent metal be carburized first to prevent such imbedding.

For the welder this new method of obtaining a wear-resistant, corrosive-resistant, heat-resistant surface on ferrous metals opens up avenues for further profitable business. Now that it is possible cheaply to prepare a metal surface, all or in part, so that its length of life is increased many times (while its thickness is not increased 1/32 in.), the welder's usefulness to industry takes another step ahead.

Gas for Detroit Comes 1,580 Miles

The recently completed Michigan Gas Transmission Corp.'s new 230-mile line of 22-in. pipe links the plants and homes of Detroit with the gas-producing wells of the Texas Panhandle, 1,580 miles distant. Overall, this is the world's largest gas line. The photographs show some of the highlights in the construction of the 230-mile lap between Zionville, Ind., and Detroit.



Courtesy The Lincoln Electric Co.

Laying a 22-In. Pipeline to Take Gas to Detroit Consumers.

Fig. 1. 40-ft. sections of pipe delivered to the site and ready for laying.

Fig. 2. "Hot dope" saves the pipe's face. In 3 minutes this gang covers an 80-ft. section of pipe with an asphaltic enamel.

Fig. 3. Out in front go the pipe stringers, laying the sections along a previously surveyed and cleared right-of-way.

Fig. 4. In only 7 minutes' time this welder makes a butt weld in the 22-in. pipe with the shielded arc, going twice around each joint and averaging 22 to 25 joints each day.

Fig. 5. The coated sections are lined up, ready for tacking and welding.

Fig. 6. Four parallel 12-in. lines, spaced 5 ft. apart, are used at river crossings.

Fig. 7. Right on the river banks, standard pipe and fitting are fused together into perfectly mated headers for each of the seven river crossings.

Fig. 8. A header feeding the four river-crossing lines. The distance between headers is about 2,000 ft., and they are located on the banks above the highest recorded water-marks.

Profitable Specializing in Welding Work

Factories, railroads and other industries equipped to do heavy welding, sometimes find it necessary to call on outside shops for light work.

A short time ago, H. K. Hagan, of Denver, Colo., was approached by a representative of a railway corporation in regard to the welding of the steel rolling doors of 30 of the railroad freight houses.

The welding department of the railroad shop was fully equipped to handle any heavy welding job, but could do nothing with the freight-house doors. An attempt had been made to repair several of them at the railroad shop, but of necessity the work was so roughly done and so much new metal had to be dressed away to allow the doors to be raised and lowered, that the doors broke at the weld.

By making a jig large enough to hold the doors in position while the work was going on, Hagan had no trouble in making a satisfactory job. It was not necessary to dress off any of the new metal, to allow the doors to be raised and lowered easily.

Another job of light welding which Hagan took over from a shop where heavy welding was done was the placing of partitions dividing large metal tanks into three compartments. This was Government work where riveting was prohibited by the specifications.

By the use of light rods and equipment especially for light jobs, Hagan did the work to the satisfaction of the Federal inspectors.

Welding fenders, and other work on automobiles, where the appearance of the completed job is of importance, is another class of work where Hagan finds his special equipment valuable. He says that with proper tools and materials it is possible to make repairs that will be almost invisible, without dressing the joint after the job is completed.

With monel metal and similar stock available in lightweight rods, Hagan finds it profitable to repair modernistic metal furniture of all kinds. Floor lamps, andirons and other fireplace accessories make up the bulk of this work.

Awards Contracts for Eight Oil Tankers

The Standard Oil Co. of New Jersey, entering upon what is said to be the largest shipbuilding program ever undertaken by a private corporation in the United States, has awarded contracts for the construction of eight oil tankers at a total cost of more than $13,000,000, the execution of which will require approximately 7,000,000 hours of labor. The vessels, which will range from 12,000 to 13,000 tons each, will replace obsolete boats in coastwise service.

Federal Shipbuilding & Dry Dock Co., Kearny, N. J., will build four of the tankers; the Bethlehem Shipbuilding Corp., Ltd., will build two at their yards at Sparrows Point, Md., and the remaining two tankers will be built at Chester, Pa., by the Sun Shipbuilding & Dry Dock Co. Though it is not reported to what extent welding will be used in the construction of these vessels, it is significant that all the companies mentioned have made extensive use of welding in the building of tankers and other craft.

Cuts Costs and Speeds Construction of Gas Pipeline

By C. W. GEIGER

THE Pacific Gas & Electric Co. recently completed a second natural-gas pipeline from Milpitas in Santa Clara County, Calif., into San Francisco at a cost of approximately $1,650,000, the purpose of this being to provide an alternate source of supply as protection against possible service interruptions.

The new pipeline is of 22-in. all-steel, high-pressure, double-bell pipe, with a thickness of 5/16 in., both longitudinal factory joints and field welds being made electrically. The pipe was fabricated by the Western Pipe & Steel Co. at South San Francisco and delivered in 30- and 60-ft. lengths and laid in a trench about 30 in. wide and 40 in. deep.

Pipe Delivered in 30-Ft. and 60-Ft. Lengths

Some of the 30-ft. pipe were welded into 60-ft. sections at the plant for transportation to the trench. The contract called for more than 7,900 30-ft. lengths of pipe, each weighing 2,170 lb. and built for a working pressure of 250 lb. per sq. in.

Work on the project involved difficult problems of engineering, construction and transportation. In some places the line goes down into deep ravines and under stream beds; in others it traverses rocky stretches where dynamite had to be used.

Approximately 1,000 double-bell angles were made for use in the many bends, so that it was not necessary to make field angle welds.

Thirteen and a half miles of the gas main was completed by the Pacific Gas & Electric Co.'s own construction forces, the remaining 31½ miles being built by the Youndall Construction Co., of San Francisco.

The sections as they were received from the plant were unloaded from the trucks and trailers and lined up along the trench, this being accomplished by cranes mounted on tractors and motor trucks.

From 8 to 10 pipe sections were tack welded together as they rested on skids placed across the trench. Then the rolling welding crews welded the sections together.

Just prior to making the rolling welds, each length was tested with compressed air, using the soap-suds test. Similar tests were made after completing the rolling welds, the pipe under test being as much as 2 miles long in some instances. The final joint welds were then completed and then lowering into the trench began.

Tractors With Hoists and Booms Speed Lowering of Pipe

One method of lowering was by the use of two tractors or motor trucks, each equipped with a hoist and a boom, and working from 200 to 300 ft. apart. By means of the hoist and boom a section say from 200 to 300 ft. in length was picked up sufficiently to enable the workmen to remove the supporting timbers, after which the pipe was let down. Then the earth was backfilled into the trench by bulldozers or by tractors or trucks equipped with boom-type backfillers.

Before the line was constructed, a soil survey was made along the entire right-of-way to determine the possible dangers of corrosion or electrolysis. As a result, it was decided to double-wrap a large part of the pipeline and single-wrap the remainder. The pipe, in the original 30-ft. sections, was first primed and then wrapped spirally by a pipe-covering machine. The covering was cemented in place by means of a highly refined

Shot-Blasting Pipe Before Priming.

(Due to soil conditions, the pipe had to be thoroughly protected. Otherwise the benefits of welding would have been nullified by corrosion.)

Many Bends and Turns Were Necessary in the 45 Miles of Pipe.

bituminous compound melted and applied hot. In addition to the coat of this compound between the covering and pipe, another coat was applied between the two layers of covering on the double-wrap, and an extra coat on the outside layer previous to application of the final wrapping of express paper, which protected the entire treatment on the pipe surface.

After being wrapped, 2 30-ft. sections were welded together for transportation to the pipeline where the contours of the land permitted 60-ft. sections, but in hilly country where there were many bends and turns, the 30-ft. lengths were used.

The welding was carried out by H. C. Price, Inc., of Bartlesville, Okla., who used 300- and 400-ampere gas-engine-driven welders. All welds were made with chill-rings. The rolling welds were made with two passes, using 5/16-in. and 3/8-in. electrodes. The bell-hole welds were made with 3/16-in. electrodes, using 3 and 4 passes.

Welding Two 30-ft. Sections Together.
(Such sections, which were used only where the grade was fairly level, were made at the plant and transported to the job.)

Launch Four Welded Barges For Gasoline Transport

By EDWARD H. SYKES
Pittsburgh Correspondent,
The Welding Engineer

The Bethlehem Steel Co., of Pittsburgh, Pa., late in June, launched four all-welded gasoline cargo barges for the Campbell Transportation Co., of Pittsburgh, from the steel-company's marine ways at Leetsdale, Pa., on the Ohio river, a few miles below the heart of the metropolis.

These barges account for only a portion of the $600,000 worth of steel floating equipment which the Campbell Transportation Co. has purchased this year, so far, in a vast inland-waterway expansion program. The company, which is affiliated with the John W. Hubbard interests, nationally known shovel and hardware manufacturers, is one of the largest river-transportation organizations in the United States. Charles Campbell, head of the company, is an enthusiastic welding advocate.

Each of the four barges has a capacity of 8,500 barrels and, fully equipped with pumps and piping, cost in the neighborhood of $30,000 apiece. They will be used to transport gasoline and other petroleum products on the Mississippi and upper Ohio rivers.

The barges, of arc-welded construction, each have ten separate compartments for the storage of petroleum products. They are 195 ft. long and 11 ft. deep, with 35-foot beams. They have been classed as A-1 oil barges by the American Bureau of Shipping and are provided with the latest safety devices for handling flammable and explosive liquids and gases.

Welded 6½-Ton Crankshaft Avoids Large Time Loss

By BENJAMIN NAPHEYS

A job of heavy welding recently completed by The National Welding Co., Denver, Colo., was the means of saving a customer several thousand dollars, as well as avoiding 6 months' loss on the use of a piece of machinery vitally necessary in the customer's business.

The crankshaft of an ammonia compressor in the plant of a local ice and cold-storage company broke at one of the main bearings. The shaft weighs 6½ tons. Putting in a new shaft meant laying up the machine for many months, and an expenditure of several thousand dollars.

It was decided to repair the old shaft by welding, but after getting the shaft out it was discovered that the metal at the unbroken end of the bearing was crystallized, so the entire bearing was cut out and a new piece of metal welded into the shaft.

The crankshaft was first laid out perfectly straight on a level base. The new metal for the main bearing was put in place and held in position by blocks and wedges, and trued up with the rest of the shaft before the weld was made.

After the welding was completed the shaft was put into V-blocks and slight bends were taken out by the heat method. When the shaft was replaced the new bearing proved a perfect fit.

Six days were required to take out the crankshaft, weld in the new bearing and replace the shaft, ready to operate. The compressor was immediately put into service, and has been running perfectly, without even heating the new bearing.

Launching One of the 8,500-Barrel Cargo Barges.

The Handling, Storage and Proper Control of Compressed Gas Cylinders . . .

Paper read at the 36th annual convention, International Acetylene Association, Cleveland, Nov. 12-15, 1935.

By F. R. FETHERSTON
Secretary, Compressed Gas Manufacturers' Association

OF ALL the products of the chemical industry, the gases are the most intangible and are, therefore, as a class, relatively difficult to prepare for convenient use and storage. In order to make a gas available for commercial uses it is necessary to compress it or otherwise to concentrate it in a relatively small volume of space, and this requires that it be placed under pressure. In the case of acetylene the gas must also be dissolved in a suitable solvent. To hold these gases under the pressures necessary to make them available for commercial use, steel cylinders are employed.

These cylinders constitute a special class of storage container on account of their singular use, and are made of special high-quality steels compounded to have characteristics that are essential for the type of service to which they are subjected. They must withstand all conditions due to internal pressure and the physical characteristics of the gas; they must also withstand all normal handling and use, and unfortunately some unnecessary abuses.

Cylinders Are Not Intended for "Extraordinary" Usage

It is easily understood that compressed-gas cylinders could not be designed to serve every kind of use for which their convenient size and shape often recommends them. For instance, owners have at times found thoughtless people using gas cylinders for rollers as a convenient means for moving heavy objects. Obviously it would be impossible to construct these containers to withstand such abuses without excessively increasing their weight, cost of production, transportation and every other item incident to the overhead of supplying gas to the consumer. A Federal law requires that all compressed gases transported in interstate commerce must be in containers that comply with the rigid specifications of the Interstate Commerce Commission; also that these cylinders must be maintained in accordance with their rules and regulations. Many state and municipal authorities also require similar compliance within their respective jurisdictions.

These specifications and regulations form the backbone of the industry upon which is based its fundamental security. They are the guarantee of safe cylinder equipment, and the consumer should insist upon the gas manufacturer furnishing him with cylinders properly marked to indicate compliance with the Interstate Commerce Commission requirements.

Each Cylinder Is Subject to Rigid Inspection

Compressed-gas cylinders are safe and convenient packages for the purposes for which they are intended. Their owners are responsible to Federal authorities for proper maintenance, inspection and testing at stated periods. At the time of its manufacture and on being approved for service, each gas cylinder is recorded with the responsible Federal agency and is stamped with the required identification markings. The life record of each cylinder is completely dependent upon preservation of these identifying characters. Throughout its entire service life, therefore, its record must be maintained. Users can cooperate with the cylinder owners by taking precautions to avoid any action which would tend to mutilate these markings, whether they be stamped in the cylinder wall or attached to the cylinder on a name plate.

Each company depends upon these markings also as a means of identifying their property. Very often cylinders are found by gas manufacturers and by users which bear markings that they cannot interpret. For that reason the Compressed Gas Manufacturers' Association, at 11 West 42nd St., New York, N. Y. maintains a rather complete record of all cylinder identification markings. These records are used by the railroads and other public carriers throughout the entire United States and the Dominion of Canada as a source of information for determining ownership and subsequent disposition of cylinders that are not accompanied by shipping orders or are not properly tagged. Similarly, many astray cylinders are returned to their owners through that Association, which will furnish forms to anyone interested for the purpose of reporting the location of astray cylinders.

All users of compressed gases ought to be cylinder conscious. Not only the employees who handle the cylinders but those who are responsible for the purchasing, inventories, distribution, safety practices and insurance should make it a definite part of their routine to see that this property, which is loaned to the gas consumer, is properly handled and stored while in their care. The remarks that follow are intended to suggest some of the more important recommendations concerning the handling and storage of oxygen and acetylene cylinders. They also attempt some suggestions concerning proper control of cylinders while in the user's possession. The term "control" is used in the sense of proper care, proper use and proper limitation of the quantity of cylinders borrowed in relation to the user's actual requirements.

One of the first rules for the proper handling of compressed gas cylinders is to prevent their being dropped or striking each other violently. This general precaution, if kept well in mind, will suggest other practices which should not be attempted, such as the lifting of gas cylinders with a magnet, or moving them from place to place by means of a rope or chain sling. While in portable service, they should be conveyed by a suitable truck or securely fastened to a safe cradle or platform. They should be kept far enough away from actual operations so that sparks, hot slag or flame cannot possibly reach them.

Keep Cylinders Out of Water, Mud and Away From the Curious

If cylinders are used on docks or near waterways, care should be exercised to see that they are not submerged in water or mud. When operations are near public highways, in buildings, or other places to which the public has ready access, precautions should be taken to keep well-meaning but curious people from tampering with the cylinder or its attachments.

If gas cylinders have been used in trenches or other excavations, make sure that all such cylinders have been removed before refilling is started. A cylinder buried under the ground is not only lost to service, but may under cer-

tain conditions constitute a troublesome hazard.

It is sometimes necessary to use gas cylinders on scaffolds or temporary stages, and when so used they should be securely fastened so that they cannot fall or be the cause of employees tripping as they move about them.

When operations are conducted in confined or cramped quarters it is always preferable to have the cylinders placed a reasonable distance away. The use of extra hose will make this possible. In such cases an attendant should be near the cylinders to shut off the valves if an emergency arises.

Gas Should Not Be Transferred From One Cylinder to Another

Sufficient emphasis can hardly be given the rule that oxygen and acetylene must never be transferred from one container to another; neither should other gases, chemicals or compressed air be placed in cylinders intended for other specific gas service, even though informed by other persons that no hazard is involved. Very often even experienced chemical engineers fail to recognize the potential hazard that may result from this misuse of gas containers.

All users of oxygen should be aware of the violent reaction of high-pressure oxygen with oils and greases. For this reason one should never permit the handling of cylinders or apparatus with oily hands or gloves nor allow oil or grease directly or oily waste or rags to come in contact with oxygen cylinders, valves, regulators, gauges, or other fittings.

It is recommended that gas cylinders be stored inside of suitable ventilated buildings. They should be kept away from radiators or other sources of heat; also protected from moisture and accumulation of ice or snow.

Oxygen is not an inflammable gas but is a supporter of combustion. Therefore, such cylinders should not be stored near inflammable material, especially oil, grease, or other substance likely to cause or accelerate a fire.

Protect Cylinders from Passing or Falling Objects

When storing gas cylinders, be sure that they are well protected from damage by falling or passing objects. It is a good rule to avoid storing or leaving cylinders in out-of-the-way places; not only may they be lost, but other materials may become piled about them, causing an unnecessary fire hazard.

Acetylene cylinders should always be stored and used with the valve end up. They should not be allowed to rest on their sides.

We have mentioned the care exercised by cylinder owners to maintain them in proper condition. The users of these cylinders have possession of them for much longer time than the owner, and for that reason it is a part of their responsibility to exercise a reasonable degree of control so that the cylinders will give the full measure of service for which they are intended.

Buy Gas Only as Needed; Avoid Stocking Too Much

Full cylinders should be ordered by a purchasing department in direct proportion to the current usage. One need not carry excessive stocks of cylinders in reserve, as all distributing stations pride themselves on their prompt delivery service. Storing more cylinders than required merely adds to the amount of money tied up in these materials and increases the difficulties of proper control.

A frequent inventory of cylinder stock will prevent the loss or misplacement of cylinders, aid in keeping the user's and the supplier's record in agreement, and assist in keeping full cylinder stock down to normal. Stray and empty cylinders not returned to the shipping department can be located. Stocks carried by individual departments can be checked for excesses. Waste to the user can also be eliminated if a practice is made of marking the approximate remaining contents on partly used cylinders with white chalk (oily crayon should not be used), and then using what is left in them before starting to use full cylinders.

Mark all empty cylinders clearly and remove them promptly from the operating point to the shipping room for return to the supplier. Keep those empty cylinders separate from full ones so that the stock of gas on hand may be readily determined. Cylinder caps should be replaced on empty cylinders and returned with them.

The storekeeper, or individual in charge of full cylinders, should, wherever practicable, release a full cylinder only upon the return of an empty one by the operating department. When operations are sizable, a simple internal record of movements by departments on a quantity basis is of immeasurable benefit.

The storekeeper and purchasing department will find such a record invaluable. Many users specifically control the transfers of cylinders from point to point through such records to see that all cylinders when empty are returned promptly to the supplier, to prevent loss and to fix responsibility for damage which may occur if proper physical care is not exercised.

Check Return of Cylinders From Temporary Jobs

A double check should be ordered on the return of cylinders from temporary operating points to prevent them from going astray or falling into the hands of inexperienced persons who may attempt to use the container or contents for purposes other than that intended.

Cylinders held in reserve for emergency or infrequent use at isolated points should be inspected at reasonable intervals to see that no damage has occurred to the cylinders and that the cylinders contain an adequate supply of gas.

If at any time a cylinder shows signs of being damaged, or gives evidence of leakage at the valve or safety device, return it to the supplier with an explanation so that a special inspection may be made. When cylinders are observed in odd or stray places and no evidence of recent usage is apparent, notify the supplier so that he can prevent their going into careless hands.

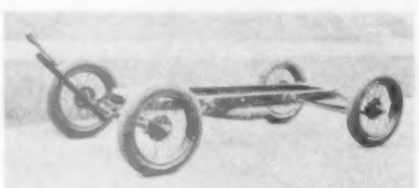
Ask for Copy of Rules for Care of Cylinders

The Compressed Gas Manufacturers Association has published a set of rules for the safe handling and storage of gases that apply not only to the gases used in the oxyacetylene industry but also include other compressed gases. Copies of these rules will be gladly furnished to anyone desiring them, either from the office of the Association, at 11 West 42nd St., New York City, or from the International Acetylene Association.

As a final thought let me leave with you one admonition that applies to the gas manufacturer and the gas user alike —*be cylinder conscious.*

New Company Makes All-Welded Boat Trailer

The American Trailer Works has been formed to manufacture, by the arc-welding process, 2-wheel and 4-wheel boat trailers, using Ford front axles and frames. They are located at 1032 South 41st St., Milwaukee, Wis. They are also making 4-wheel and 2-wheel trailers for mounting gas-engine-driven arc welding sets. Henry Manske is manager.



Welded Boat Trailer Made by Milwaukee Concern.

Before employing welding in its steam-circulating system, an Eastern plant needed 60 steam-fitters constantly. After introducing welding, the same plant, although its output has been trebled, uses but 20 steam-fitters and 12 welders.

Get "H. O. T." on Welding

By H. O. T. RIDLON

Old-Timer Asks for a Showdown

A friend—a welding-shop proprietor—writes the Old Maestro the following letter:

For some time we have been forced to read your writings and at times listen to your talks on welding. Now, the writer has been connected with this thing called welding since 1910 and has heard quite a little discussion on same, but what is this welding?

The American Federation of Labor does not list it as a trade. The United States Department of Labor does have an industry listed as welding. Thousands of people don't know what can be done with it.

We poor eggs who face this flame day in and day out are just men of the world.

Now let us get together and bring this thing to a showdown and have it understood that welding is an industry and that welders are men of real learning and that there are engineers, and experts among us that can stand up before any industry.

It seems that I have been given a mission in life to fulfill. But, just how I'm to go about fulfilling it, I don't know because the world in general doesn't read our trade papers. And, me doubts seriously if any other nationally read "sheet" would print what I write. The Fusion Party might print it, but as yet they haven't one thin dime in their treasury. Now here's a gent that wants something done and he does not support his party. Beg your stuff, perhaps he doesn't want to belong to the Fusion Party.

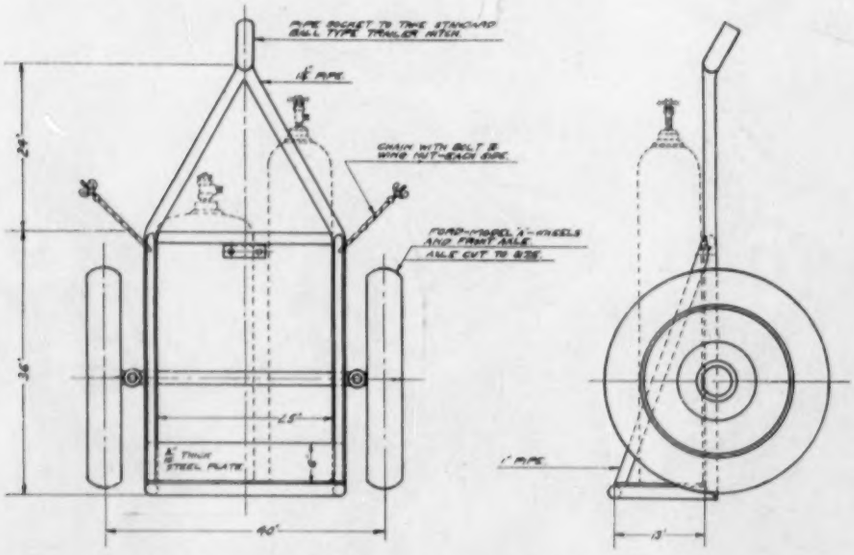
In the last line in his second paragraph, he says, "Thousands of people don't known what can be done with it." People? Hell, my friend, even most welders or so-called welders don't know what can be done with it. I know I don't. What is happening today, a few years ago I would never have guessed could happen. What will happen in welding ten years from now, I dare not even dream about. And who a hundred years ago would have dared dream about brick-layers and structural-steel men and carpenters and plumbers and steam-fitters building up in the air a structure fifty or sixty stories high. Through generations these trades have gone forward and become known for what they are, not from some story or "ad" or publicity stunt, but because they did things.

Great crafts of the past have been lost to the world forever because some old fogey kept locked within himself the things learned only from experience—afraid to pass it on to younger men, and not willing to listen to or try new things.

In a great Eastern city a chap has a sign hanging out saying that he welded difficult metals. While I was talking with him, one day, a customer walked in with a job. The shop owner looked at it and said, "It is white metal, it can't be welded." Now, this lad has been in the game, he says, for twenty years, and he reads no trade papers. Well, to make a long story short, he now knows how to weld white metal.

But we all have to learn. However, most of us don't take advantage of the chances we have to learn.

Now let's go back to our protesting friend. He has a nice business, but his shop is like thousands of other welding shops. Just a place to earn wages. And he has and has had for years the chance to have one of the swellest shops in the country. But it seems that he is like many others; he thinks that you don't have to merchandise. But that's where he's all wet.



Rear and Side View of the Welder's Cylinder Trailer.

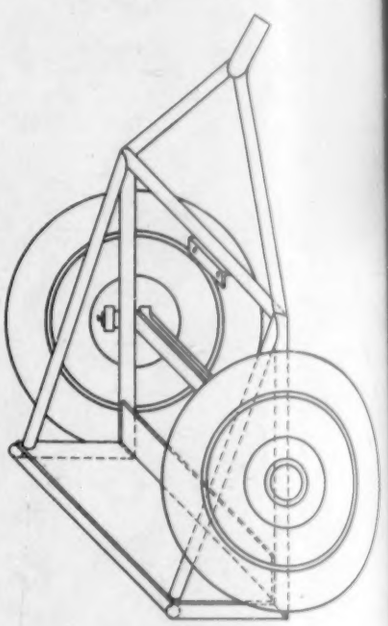
(You can make this up out of scrap material and a couple of automobile wheels. You'll find it just the thing for hurry-up calls.)

And if he wants welding to become better known, let him take advantage of his opportunities to sell welding, and the rest of the shops about him will follow along or fold up. It will be like dropping a stone in a quiet pool—the ripples will spread and spread for all to see and understand.

* * *

An Outfit for Quick Service

Business is looking up. Things are better, and when things start to get better we must look towards things that will help keep them that way. And to welding shops the all-important item is *service*. Not all shops have two trucks; and it is rather hard on the family car,



Perspective of the Trailer.

or any car for all of that, to throw a couple of tanks into it and dash out to a job. And it looks like the devil, too.

So I got my good friend Earl Evleth into a corner one day and here are some drawings that came out with us. The idea being to have a spare outfit in a tool box ready to go any time. When the rush call comes in, and the truck is not available, hook your trailer onto any car you have handy, put the tool box on the floor of the car and take your man to the job and leave him until he's through, and you can get back to your shop. A shop owner should not go out on jobs unless it cannot be prevented, but be on hand to take 'phone calls and take care of customers coming into the shop.

And just in case some of you gents don't know it, you can get these steel tool boxes that have places for your regulators, torch, hose and tips and wrenches.

You don't have to use Ford wheels on it. I'd suggest using the same kind of wheel and the same size as you have on

your car, just in case you have to change tires.

And, don't forget, should you make one of these, to put a nicely painted sign on it telling the world about your shop in a few simple well-chosen words.

Last, but not least, make each weld on it just perfect in every respect, because those welds will do a lot to sell your service and welding in general.

* * *

The thought for the month: To be—do!

Notes on Metal Spraying

Building Up Pump Rotor.

High-Carbon Steel for Wearing Surfaces

The building up of a pump rotor and of a roll bearing are two interesting applications of metal spraying recently done by the John Nooter Boiler Works Co., St. Louis, Mo., using a machine lathe.

The pump rotor, 14 in. in diameter, was built up 0.060 in. with 1.20%-carbon steel. After finish grinding, this presented a file-hard surface. The pump casing (not shown) was built up at the same time with an equal thickness of metal, thus putting back into service a unit at only a fraction of the cost of a new one. The company for whom this job was done reports that the reconditioned unit is wearing far better than the original pump.

In the case of the roll bearing which is illustrated, this also was built up with 1.20%-carbon steel, resulting in an approximation of a case-hardened surface

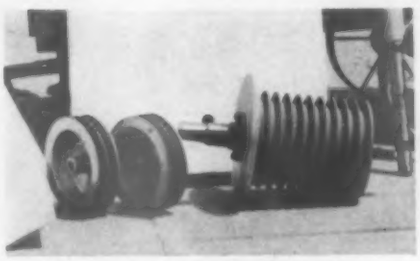
Spraying a Roll Bearing.

1/16 in. thick on the diameter after finish grinding. Each end of the shaft was built up for a length of 13 in.

R. J. Ryan, of the John Nooter company, reports that they have built up quite a number of shafts and pumps with their "Metallizing" gun, and all these have been highly successful. They see a big future for this type of business.

Longer Life Given Aluminum Pulleys

Because of their light weight, V-pulleys made of an aluminum alloy are desirable for airplanes, but the soft metal wears quickly. To eliminate this difficulty, the grooves of the pulleys are sprayed with 1/32 in. of cold-rolled



Steel-Sprayed Aluminum Pulleys.

steel, which gives a harder and more lasting surface. Before spraying, the pulleys are blasted with steel grit so the sprayed steel will make a good bond to the aluminum, according to H. B. Rice, of the Metalspray Co., Inc., of Los Angeles, Calif.

Worn Pump Rods Built Up at Big Saving

One of the large Western railroads is building up their worn monel-metal pump rods for reciprocating water-feed locomotive pumps by spraying monel metal onto the worn rods by means of a "Metalspray" gun. A typical job of this kind was recently completed for $8, compared with a cost of $40 for a new rod.

Sprayed Lead Makes Welded Seams Smooth

To make smooth the arc-welded seams in a removable gasoline truck tank, molten lead was applied by a spray gun along the seams, using ⅛-in.-diameter

Gas Tank With Sprayed Seams.

lead wire, and then the seams were scraped smooth so that all cavities and irregular surfaces were filled. After this treatment, the tank was enameled. Thirty tanks were treated in this manner, at an approximate cost of $5 per tank. In California, this has become a standard application in the construction of truck tanks, reports H. B. Rice, of the Metalspray Co., Inc., of Los Angeles.

California Shop Owners on Vacation

It would seem that the California job shop owners had declared the season open for vacations, from the number who are taking theirs at this time. Many more perhaps may be away than are here mentioned, and, perchance as many are contemplating a "breathing spell," but the following have just been called to our attention:

A. C. ("Red") Munsell, of the Orange County Welding Works, of Santa Ana, is on an extended vacation trip to points East, including Minneapolis.

Paul B. Hughes, of the Soto Welding Works, Los Angeles, will return this month from a few weeks spent in Illinois and in Detroit.

H. ("Shorty") Brann, of the Mission Welding Works, Los Angeles, is taking a trip to his old home in Hudson Falls, N. Y. During his "sojourn," Mr. Brann will take time out and attend the Hobart welding instruction classes at Troy, O. He expects to return via Detroit, from where he will drive home in a new Plymouth car.

W. J. Williams, of the Williams Welding Works, Huntington Park, is away spending a few weeks in the cool and scenic land of British Columbia. Much of his time will be spent at Vancouver.

And, last, but by no means least, A. W. ("Art") Johnson, of the National Electric Welding Corp., Huntington Park, is taking his much-earned vacation in beautiful Yosemite Valley, of California.

By substituting welding for casting in making jigs and fixtures an eastern manufacturer has cut his costs an average of 20%.

"Investigate and Follow-up" Is Collection Formula

By JOHN T. BARTLETT

Credit, skillfully extended, builds sales volume. The right formula and methods will hold losses to a reasonable figure. This investigator commends the practices of W. I. Reynolds, who, for 19 years, has operated the Standard Machine Works, Boulder, Colo.

Much of this shop's welding patronage comes from the Boulder county mining area to the west. There are some large operators, but local mining is notable for the numerous small projects. There are shoe-string mining ventures, and out-and-out wildcat enterprises. During the past three years, mining activity has surged high, with the result that the Standard Machine shop finds about two-thirds of its total volume in this field.

"About 50% of our business is on a credit basis," reported Mr. Reynolds. That is the result produced by application of two policies.

The first is careful credit investigation. Before extending credit, Mr. Reynolds gets the important facts about the customer. Information sources found especially valuable are certain other local concerns doing a heavy business with companies, firms, and individuals, operating "in the hills." The important thing is, before extending credit, to know the resources of the customer, his character, and sometimes, as with miners, the business prospects.

It is a great help to Mr. Reynolds, for example, that he knows a great deal about mines and mining.

The position taken with respect to credit for petty amounts is often that the labor and inconvenience of credit handling is unwarranted. To applicants not entitled to credit, Mr. Reynolds knows how to say "No."

The second policy which affects the relative volume of credit business is the fast follow-up. Exceptions are made for unquestionably good accounts, naturally —but, in general, credit is quickly shut off with the customer who doesn't pay promptly.

The standard follow-up is, (1) a statement on the first of month, (2) a telephone call on the 15th, or immediately following, if no remittance has been received. Making this telephone call, Mr. Reynolds is tactful and pleasant; but "gets across" that he has been surprised no payment has come in, and expects one. If now there are no results within a reasonable time, (3) Mr. Reynolds makes it his business to be in the delinquent's neighborhood and to call on him.

The Standard Machine Works has certain customers for whom there would be no follow-up even though payment was delayed three or four months. However, dealing with the kind of territory he has, Mr. Reynolds often grants credit only on the basis of fast follow-up. He will "take chances" that, without fast follow-up, would not be warranted.

Some small mine operators, for example, may ask for credit until they have had a chance to get ore to the mill, and their payment. And at certain seasons of the year, when business is normally slow, Mr. Reynolds will take on credit business he otherwise might not accept.

This applies especially in winter. The importance of keeping an organization together through the winter, ready to function at high speed as business grows, is obvious. Keeping his men busy, Mr. Reynolds will take chances he otherwise would not take.

He sets himself a bad-debt figure which, under his conditions, he considers reasonable, and then keeps within it.

In Mr. Reynolds' shop, standing against a wall, was a stoper—a piece of valuable mine equipment. A customer "went broke," owing the Standard Machine Works $135. The policy of efficient follow-up soon had Mr. Reynolds on the ground, talking with the customer. There was no money for him, or likelihood of it. However, on inquiring, he found that certain equipment was owned outright, without encumbrance. He suggested that he take a stoper, and write the bill "Paid."

The customer agreed to the arrangement. "I'm offering the stoper for the amount of my bill," Mr. Reynolds remarked, "and I am sure I'll find a buyer." That is one way for a welder to collect a difficult account.

"Playing Ball" With Garage Men Builds Business

Handling the same quantity of business today as they handled prior to 1929, and experiencing no noticeable drop at all during the depression, the Kaylor-Holman Spring Co., 314 S. St. Joe St., South Bend, Ind., has reason to feel proud of their business. They are serving over 140 accounts.

By "playing ball" with the garage man, the company has built up an enviable reputation with this class of trade, so that nearly every garage man in the city takes his work to the concern.

The company specializes, as G. E. Kaylor says, in that work which the garage man cannot do. It has been found profitable to stay out of competition with the garage man. A great many of his steady customers would like the company to carry on all repairs, but Mr. Kaylor believes in specializing, and he follows the theory that a greater and more reputable business can be secured and maintained if his concern confines its attention to just one or two lines, such as handling and rebuilding automotive springs and rebuilding wire and disc wheels, axles and bumpers in the course of which much welding is used. The company does considerable business with all the large transport and trucking lines, both commercial and passenger.

Mr. Kaylor attributes this success to three important features the company pursues. The first is the service the concern offers. As a gem of wisdom, he ventures to say that any concern can offer products to a customer, but for that concern to stand head and shoulders above the many, it must extend to the customer a service so satisfactory that it remains a pleasant memory in his mind.

The second is the keeping of a complete stock. Mr. Kaylor says that there are plenty of good gamblers in the business world, but now is the time to gamble most. An establishment without a complete stock is bound to lose not only those customers whom they are unable to take care of immediately, but the customer's friends to whom he conveys the information. A customer's confidence is essential, and when that is lost, the customer goes too. The Kaylor-Holman company during the past several years, when other concerns were allowing their stock to run low, discovered that was just when they should keep their stock up to par. As a result, many new customers found their way to the concern.

The third, and a very novel feature, results from the company's reputation, through which a large supply house, serving plumbers and steamfitters, recommends the company to these plumbers and steamfitters for repair of jobs slightly non-standard. Mr. Kaylor believes it a good method of business for welders to contact supply people. It is of mutual benefit, as the supply house can then make many sales.

A new line of business the concern has developed is the repairing of electrical appliances for electrical supply dealers. Heating units are now being sent to the company for the repairing of the broken wire leading through the insulation into the appliance. The torch is held a little more than an inch away, which insures sufficient heat for melting, and then the brass is dropped to fix the break. The appliance dealers formerly had to send these articles back to the factory. Now they are repairing them at a great saving.

British Specification on Welded Steel Drums

Welded mild-steel drums are covered in Specification B. S. S. No. 670-1936, recently issued by the British Standards Institution. This specification applies to all liquids except those which develop vapor pressures of more than 20 lb. per sq. in. absolute at temperatures below

45° C. or which have a flash point below 73° F. In view of the many alternative methods of construction for drums having a thickness of less than 18 gauge, such drums are not provided for in the specification. The specification standardizes the dimensions of drums in various capacities, from 5 to 150 gallons, and includes details concerning the method of construction and the dimensions of the bung and boss.

Welded Steel Siphons Add to Denver's Water Supply

By FRANK CONLY

OVER a mile of arc-welded steel pipe of large diameters went into the South Boulder diversion conduit which carries the water brought through the newly completed Moffat Water Tunnel from the western slope of the rockies to augment the supply of Denver, on the eastern slope.

This conduit diverts the water from Boulder Creek to Ralston Creek, where a reservoir of 12,000-acre-feet capacity is being created by the construction of an earth-fill dam 1,150 ft. long and 175 ft. high. When the dam is completed, also the new filter plant west of the city, Fraser River water will be turned directly into the city mains. In the meantime, Denver is able to benefit indirectly from the Pacific water brought through the Great Continental Divide, by trading it to water users situated below the city for water drawn from the Platte River above the city.

Eventually it is planned to bring 1200 second-feet of water through the Moffat Water Tunnel, but the present development carries only about half that amount. The water is brought down Boulder Creek from the east portal of the tunnel to a diversion dam above Eldorado Springs. Below the diversion dam comes a series of tunnels, siphons and flumes, and open canals.

There are five tunnels, six siphons and six flumes. The tunnels carry the water through spurs of the foothills; and the first siphon is in the canyon between tunnels No. 1 and No. 2. This siphon, 843 ft. long, was put in to accommodate the full-anticipated capacity of the system, and is of electric-welded steel pipe 111 in. in diameter. Siphon No. 2, between tunnels No. 2 and No. 3 is 308 ft. long, and 96 in. in diameter. Later a twin siphon will be erected alongside; and the same applies to the other siphons in the series. The tunnels were constructed large enough to accommodate the full anticipated flow when they are completely lined.

Siphon No. 3, between tunnels No. 4 and No. 5 has only 167 ft. of steel pipe (84 in. in diameter), the remaining 1,172 ft. being precast reinforced concrete pipe. Siphons No. 4 (1,208 ft.), No. 5 (2,940 ft.), and No. 6 (3,930 ft.) are in the conduit line across Stony Flats between the foothills and the plains. No. 4 and No. 5 are welded steel pipe, but No. 6 is reinforced-concrete pipe 72 in. in diameter. No. 6 is on a considerably steeper grade than the other siphons, and on the alternative bidding, concrete won out for this stretch.

When the full amount of water is brought from the western slope through the main tunnel, 6 3/10 miles in length, another siphon line will be constructed parallel with siphons No. 2 to No. 6, inclusive, to carry the additional water.

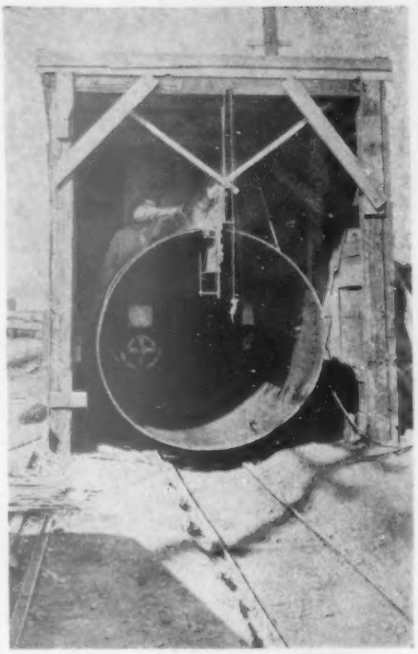
Electric welding was specified for the 5,466 ft. of steel pipe for these siphons, and called for some 15,000 lb. of electrode, of which 3,000 lb. was required in the field. The approximately 1,800,000 lb. of steel pipe is mounted on stiffener rings and rollers, supported on concrete piers, with an average span of 50 ft. There are anchor piers wherever there is a change of direction, and the expansion joints occur between the anchor piers.

Field-Welding the Pipe.

(Welders had to lie on very stony ground part of the time when working.)

All stiffener rings were welded in place at the shop. All steel pipe was air tested to withstand an internal pressure of 90 lb. per sq. in.

As an illustration of some of the hazards the contractors had to contend with in the mountains, may be cited an unexpected happening. Several 20-ft. lengths of pipe, 7 ft. in diameter, had been delivered in a draw on Stony Flats when a strong gust of wind sweeping across the draw carried the great pipes down the slope, up the next slope and across the flats. Two lengths were carried a distance over half a mile; and only a few moments before the 80-mile-in-minute gust caught them up like so much matchwood, Colonel Crocker, consulting engineer for the water board, had been standing in one of these lengths.



Welding Seams on Cylinders.

(These were used in reinforced cast concrete pipe on steep grades.)

The work of erection kept a force of 10 to 11 men almost constantly in the field for a period of about 134 days. The steel siphons after completion, were sprayed with aluminum-bronze paint.

The big steel siphons did not account for all the welding on the South Boulder conduit, as the greater portion of the precast conduit siphons were of the cylinder reinforcing type, due to the steep grades to be negotiated. This was all shop welding, incidental to the construction of the pipe.

The electric-welded steel siphons were manufactured and erected by the Thompson Manufacturing Co., other contractors being responsible for excavation and concrete piers.

■

This Section of Pipe Was Blown Over Half Mile by Strong Wind.

(Examination showed no weld fractures.)

■

Putting Showmanship Into the Welding Business

By STUART SECHRIST

A little bit of showmanship is a paying proposition in the welding business, just as in any other, judging from the experience of the Nevada Welding Works, Reno, Nevada. Here's a firm that has probably attracted more attention than any other in the state—and its business reflects the fact—through unusual publicity "stunts."

For example, the company took a portable outfit to the top of the highest nearby mountain in the district and used it for several hours one evening. The next day the newspaper published a story in this vein: "The blue light flashing on top of Mount Blank, which attracted the attention of so many Reno people last night was from the welding outfit of the Reno Welding Co. which was doing a job here. The light was reported seen from (so many miles). Some people wondered if the light might be due to the unusual condition which occasionally makes the aurora borealis visible in points as far south as this."

This interest-creating start was followed up by brief mention of some of the important work the company had handled in the district. The whole story was written in news style and was actual publicity rather than paid advertising.

"Few newspapers will give obvious free publicity but if you make news, they are glad to publish it," says owner N. D. Selfridge. "We did something that actually did attract attention and create curiosity. The paper was meeting the news requirement by publishing an answer to the question of what the light was. Of course, you couldn't use this 'stunt' more than once or twice a year at the most—but it works mighty well then."

Another time the company carried its message to the townspeople through public-address-system announcements. By working with a nearby soft-drink stand which wanted to use the equipment for drawing business off the main highway through town, the welding works brought the cost down to a reasonable level. The cost was only $20 for one announcement per day for three weeks.

The announcements were simple and to the point, in this vein: "The Nevada Welding Works, 559 E. Fourth St., is equipped to handle all types of outside welding jobs. They have a complete portable electric outfit ready for instant call." Amplification was great enough that the announcements were plainly audible in a radius of a mile.

The company's building has been an invaluable source of publicity. It is an all-metal job with a welded steel frame. Mr. Selfridge made it stand out conspicuously for the first few years by its very isolation. He picked an empty block on the highway through town, putting up the first building here. The district has built up since, but the welding shop stood by itself for long enough to become established as a sort of landmark.

To get the attention benefit from the welding light, Selfridge arranged to have fitting work done during the day and all the welding at night.

"I believe there is a big field for development in small buildings of all-metal construction," says Selfridge. "That's one reason why we put up a special building of this type. We have concrete proof of the practicality of the construction. When we have a prospect for such a job, we can actually show him what has been done. The greatest need is for education along these lines. Welded steel frames have been used in many large buildings in the East but the average small building owner isn't yet sold on the idea. The best selling method possible is getting up a few good jobs and taking people around to see them."

Free Advertising Helps Business

(The shop itself is welded. Some welding is done at night to attract public attention. Much publicity has been obtained by playing up the spectacular side of welding in the local press.)

Meetings

Chicago

A talk by H. C. Boardman, of the Chicago Bridge & Iron Works, on the welding of elevated tanks, and also a talk on welding applications, with demonstrations, by a representative of The Lincoln Electric Co., will feature the meeting on Tuesday, Aug. 4, to be held at the Welders Information Center, 741 West 70th St. Equipment on demonstration will include 100- and 300-ampere d.c. machines and a 500-ampere a.c.-arc unit of the motor-generator type. At the meeting on July 7, despite the very warm weather more than 200 were in attendance.

Los Angeles

The last meeting of the present season was held by the Los Angeles Section, American Welding Society, on June 25, preceded by the usual dinner. C. A. McCune, secretary of the Magnaflux Corp., New York City, gave a talk on "Non-Destructive Testing of Welds," illustrated with picture slides. A talk on "Sprayed Metal Coatings," together with motion pictures, was given by Robert A. Kunkler, sales engineer, Metallizing Co. of America. Discussions followed both talks.

San Francisco

"Automatic Welding of Large-Diameter Pipe" was the subject of a talk given by T. R. Rooney, plant superintendent of the Western Pipe & Steel Co. at a meeting held by the San Francisco Section, American Welding Society, at the company's South San Francisco plant, on June 26. Many of those present were taken through the plant by Mr. Rooney and guides. Preceding the visit to this plant, the Section had a dinner at "Oliver's," on Bayshore Highway, at which K. V. King presented a brief yet interesting résumé of current welding literature, and conducted a general discussion.

A resistance welder has been developed for navy-yard work which welds two thicknesses of 3/16-in. corrosion-resisting steel at a rate of 30 to 40 spots per minute.

Coming Events

Aug. 11-16. Mt. Pleasant, Mich. Second Annual Michigan Oil and Gas Exposition. For information write R. I. Taylor, manager of exposition, Mt. Pleasant, Mich.

Sept. 7-12. Washington, D. C. Third World Power Conference. For information write the Conference, Interior Bldg., Washington, D. C.

Sept. 22-25. Detroit, Mich. Iron and Steel Exposition. Also annual convention of Association of Iron & Steel Electrical Engineers. For information write John Kelly, Jr., Empire Bldg., Pittsburgh, Pa.

Oct. 19-23. Cleveland, Ohio. Public Auditorium. National Metal Congress. Also Fall Meeting of American Welding Society and meetings of American Society for Metals, Wire Association, and others. For information write W. H. Eisenman, 7016 Euclid Ave., Cleveland.

Nov. 18-20. St. Louis, Mo., Hotel Jefferson. Annual convention International Acetylene Association. For information write the Association, 30 East 42nd St., New York, N. Y.

Mr. W. I. Reynolds and his Standard Machine Works, Boulder, Colorado.

Better for difficult jobs

...says *Colorado welder of* TOBIN BRONZE

W. I. REYNOLDS
MERLE REYNOLDS

STANDARD MACHINE WORKS

COMPLETELY EQUIPED FOR EVERY JOB
1011 Walnut Street Phone 1140
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THE AMERICAN BRASS CO.,
Waterbury, Conn.

Gentlemen:

I can build Tobin Bronze in difficult places better than any other rod. We use it for welding malleable steel and iron castings in the automotive industry and believe it to be one of the most reliable welding rods on the market.

(Signed)

W. I. Reynolds

AFTER eighteen years of actual welding experience with Tobin Bronze, Mr. W. I. Reynolds praises this original low melting point bronze rod highly. "I can build Tobin Bronze in difficult places better than any other rod," he writes.

Throughout the country, good welders agree that it pays them to use good rod stock. Thousands of them use Tobin Bronze . . . identified as genuine by the name stamped every 12 inches in each rod.

ANACONDA
from mine to consumer

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ANACONDA WELDING RODS

What's New in Equipment and Supplies

Copper-Plating Solution for Hardening

To lower the cost of plating where selective hardening is necessary, a chemical compound known as Kwik-Cote has been developed by Grapho Products, Inc., 2232 Alvord St., Indianapolis, Ind. This compound deposits a copper plating on the part to be treated by dipping or painting with a small stiff brush. Hair-line separation of hardness can be secured with positive results, it is claimed. With Kwik-Cote, any portion of the part to be hardened can be treated. Preparation for hardening takes but a few minutes, as the solution dries almost at once, and the object can be placed in the carburizing pots immediately. A scleroscope hardness variation from 80 to 30 is secured. Threads treated with Kwik-Cote may be kept dead soft and in perfect condition while the remainder of the piece is hardened. Only the parts to be kept soft are treated.

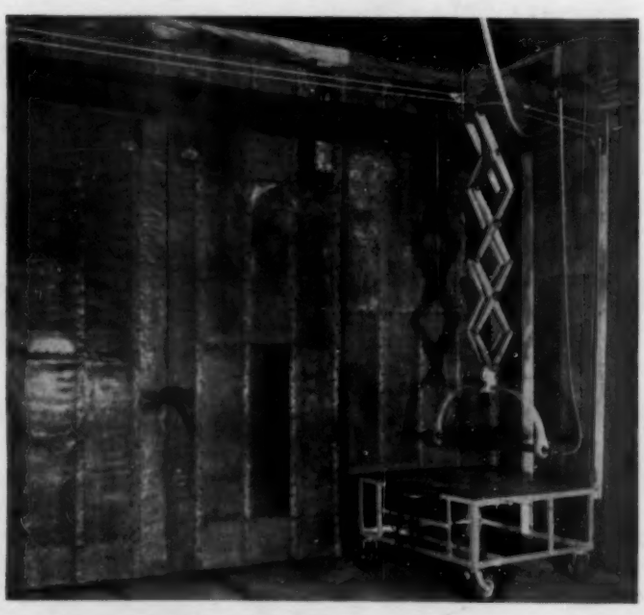
Kwik-Cote may be used between cams, back of gears, threads, in bores where stock is left for reaming after heat-treating, on springs and any section to be kept soft. The solution may be used as a base for nickel or chromium plating. The work is thoroughly cleaned, dipped in the solution, the surplus liquid washed off and it is ready for plating.

"Lazy Tongs" Aid in Industrial X-Ray Work

In industrial x-ray work, the problem of supporting and fixing the .tube and leads in the desired position during radiographing has been solved in the Schenectady Works Laboratory of the General Electric Co. by the development of a system of support using "lazy tongs." The tongs are constructed of kiln-dried, treated maple wood, and are connected to a traveling crane of the same material through a joint which permits the tongs to revolve through an angle of 180° in a horizontal plane.

The motion of the tong mounting on the cross member of the crane, and that of the cross member itself, is controlled through guide ropes and pulleys. The x-ray tube is mounted in a maple-wood bow which may be held in any position along its length by use of a smooth clamp at the lower end of the tongs. The pantograph motion of the tongs allows a wide variation of heights for radiographic operations. The high-potential leads are carried to the tube terminals through insulated pulleys mounted on arms extending from the tong support.

With this apparatus, radiographs may be taken at any angle, height, or location within the lead-lined building.



By Means of "Lazy Tongs" Controlled by Guide Ropes and Pulleys, the X-Ray Tube Is Easily Held in Any Position.

A. C. Transformer Welder Has 15 Heat Stages

An a.c. arc welder of the transformer type, with 15 progressive heat stages, has been announced by the Marquette Manufacturing Co., Inc., Minneapolis, Minn. This new Marquette welder is said to have a current range of 30 to 175 amperes and will handle electrodes up to 3/16 in. in size. It can be attached to any 220-volt a.c. circuit. It is equipped with noiseless composition casters for easy handling.

"Marquette" Transformer Welder.

Trade Literature

"General Data Book," a 192-page booklet on steels, has been published by Joseph T. Ryerson & Son, Inc., Chicago, Ill. Included are shop data on tool and alloy steels, physical properties of various S. A. E. and other steels at room temperatures and at various drawing temperatures, effects of various elements on alloy steel, definitions, S. A. E. and A. S. T. M. specifications, engineering data on drawn shapes, elements of structural sections, and miscellaneous tables.

"Lower Piping Costs With Shielded-Arc Welding" is the title of a booklet issued by The Lincoln Electric Co., Cleveland, Ohio, giving comparative cost curves for welded, flanged and threaded pipe joints, also electrode data for various sizes of pipe, and time and weight of electrodes consumed for various diameters. A wide variety of welded-pipe installations are shown.

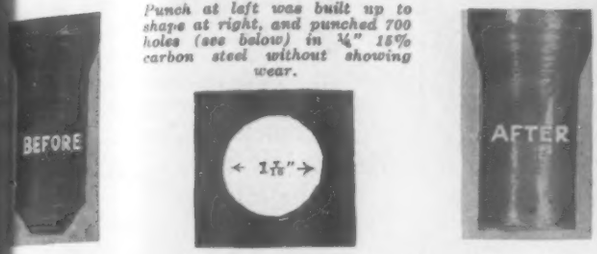
"Metal Cutting by the Oxyacetylene Process" is the title of an illustrated booklet, by J. H. Edmundson, published and distributed by the Acetone Illuminating & Welding Co., Ltd., Napier, New Zealand. Beginning with the elementary principles of combustion, the author progresses into the theory of oxygen cutting, and shows the importance of high oxygen purity.

"Lower-Cost Manufacturing by Shielded-Arc Welding" is the title of a booklet issued by The Lincoln Electric Co., Cleveland, Ohio, explaining the structural advantages of steel over ordinary gray cast iron and giving many exam-

AGILE *Dark Green* Rods

"Especially For Hard Wear"

Punch at left was built up to shape at right, and punched 700 holes (see below) in ¼" 15% carbon steel without showing wear.



IF YOUR welded or built-up section must sustain unusually hard wear you need Agile Dark Green Electrodes!

The pictures above are eloquent testimony of the wear-resisting qualities of this splendid rod.

At the left is a hard metal-punch with a beveled end, which was built up with Agile Dark Green Arc Rods into the square shoulder shown at the right.

With this reconstructed section this punch drove 700—1-7/16 holes through ¼ in. 15% carbon steel (see center picture)—AND SHOWED ABSOLUTELY NO SIGNS OF WEAR!

Agile Dark Green Arc Rods are just the thing for repairs to machining tools, cutting edges, plow shares, punches, etc. Also for cold-welding pig-iron castings. They make a clean, dense weld, produce no slag, and become glass-hard when quenched.

Request free sample and information regarding our complete line of rods for all purposes.

AMERICAN AGILE CORPORATION
3806 Hough Avenue — Cleveland, Ohio

TRADE COMMERCIAL ACETYLENE MARK

"COMMERCIAL" is widely known for its PURITY, UNIFORMITY and RELIABILITY, and its Organization for Service to the Industry.

Whatever your Acetylene requirements, you should know about our sales plan.

Ask our nearest office for details

Supplied in following size cylinders:

125 cu. ft. capacity
225 cu. ft. capacity
275 cu. ft. capacity

[We also sell oxygen and a complete line of Oxy-Acetylene Apparatus and Supplies.]

COMMERCIAL ACETYLENE SUPPLY CO., Inc.

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40 Rector St., New York

BRANCHES
600 W. Jackson Blvd. CHICAGO
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680 Hamilton Ave., S. E. ATLANTA, GA.

THE MARK OF SERVICE

TO THE SMALL WELDING OPERATOR

M-W has a very definite service for the smaller independent or plant welding shop operator. The fact that many of the largest users of welding processes rely on M-W for equipment and supplies as well as Engineering Service in no way restricts M-W activities among smaller shops.

To us, the small operator presents a dual picture. He represents, first, the potentially large operator of the future, and, second, he represents, now, a steady backlog of constant business that does much to stabilize our activities.

We like that kind of business and ask only the opportunity to demonstrate our service and willingness to cooperate fully.

Do not let the limitations of your present welding requirements keep you from taking advantage of M-W Service. Call or write our closest office.

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1705 Baltimore

ELECTRIC ARC • RESISTANCE • ACETYLENE • WELDING EQUIPMENT

Electrode Holders
Arc Welding Cables
Cable Connectors
Helmets
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Goggles
Respirators
Protective Glasses
Protective Clothing
Aprons, Gloves, Spats, Sleeves, Leggings.
Welding Hose and Connections.
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Acetylene Generators.

MACHINERY AND WELDER CORPORATION

WE RENT WELDING EQUIPMENT

RYERSON *a dependable source for* WELDING ROD

Ryerson Engineers have developed a series of rods that are outstanding for Quality production. More than twenty types including both electric and gas rods are carried in stock. Whether you need a shielded arc type for production work or a stainless steel rod you can be sure of immediate shipment.

Write for Samples to Test

ELECTRODES

Ryerson Shielded Arc Type No. 215
Ryerson Shielded Arc Type No. 216
Ryerson Shielded Arc Type No. 217
Ryerson Green Processed No. 18
Ryerson Green Processed No. 6
Ryerson Bare Mild Steel
Ryerson Brown Processed
Ryerson White Flux Coated
Ryerson High Carbon White Flux Coated
Ryerson Blue Flux Coated
Ryerson 3½% Nickel Steel Flux Coated
Ryerson High Manganese Steel
Ryerson Hard Surfacing
Ryerson Allegheny Stainless Flux Coated
Ryerson Allegheny Stainless No. 44

GAS RODS

Ryerson Copper Coated No. 206
Ryerson Copper Coated No. 210
Ryerson Cast Iron
Ryerson 3½% Nickel Steel
Ryerson Tobin Bronze
Ryerson High Carbon Bare No. 2110
Ryerson Allegheny Stainless Bare
Ryerson Hard Filler

JOSEPH T. RYERSON & SON, INC.

Chicago. Milwaukee. St. Louis. Detroit. Cleveland. Cincinnati.
Buffalo. Boston. Philadelphia. Jersey City

ples of how welded rolled steel assemblies have been designed to replace castings at considerable savings in cost.

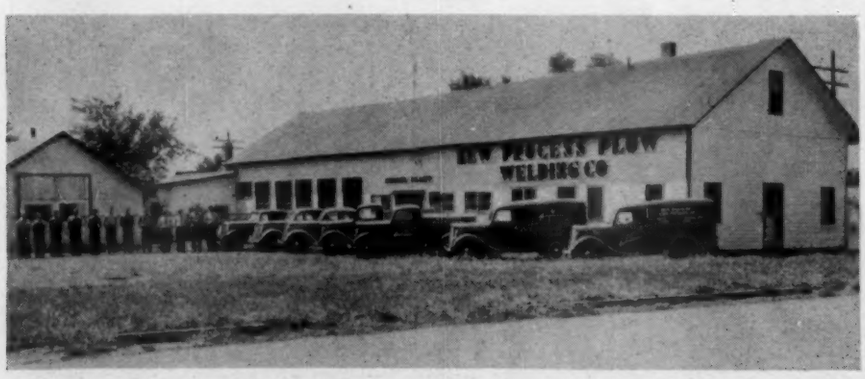
Eisler a.c. arc welders of both the stationary and portable types are shown and described in booklet 36AC, issued by the Eisler Engineering Co., 749 South 13th St., Newark, N. J.

The advantages of hollow screws in machine design are set forth in a booklet issued by The Allen Manufacturing Co., Hartford, Conn. Design data are given.

Commercial News

New Process Plow Company Opens New Factory

The New Process Plow Welding Co., of Perry, Iowa, has leased a building for the manufacture of a complete line of cultivator shovels, lister shares, sweeps, wheat drills and other farm tillage tools, which is in addition to their line of plow welding units. Work of installing the machinery and dies is progressing rapidly so that samples of shovels will be ready in a few weeks.



New Factory for Making Farm Tillage Tools.

The building contains 3,720 sq. ft. of floor space. The superintendent of the plant is P. O. Thompson, who has had many years' experience in the manufacture of shovels. H. O. Weise and his son, Lee O. Weise, are co-partners in the venture.

The second annual dealers' meeting will be held by the company in Perry, Iowa, on July 31 and Aug. 1. Prizes will be awarded for the best work on display.

Williams and Company Holds Welding Clinic

In response to an invitation to a week-long "open house," 75 representatives from 36 different industrial companies came to Williams & Co.'s welding laboratory in Cleveland, during the week of April 27, to see and experiment with Westinghouse's new series-type FlexArc welder. Specific hours were reserved to accommodate the engineers and welders from each firm represented.

Invited to bring any particularly difficult welding problems with them, many operators brought actual parts for welding. "We can honestly say we handled these," reports Williams & Co.'s district manager, J. H. Penske, Jr., "with the exception of two or three, to the entire satisfaction of the companies involved. In the two or three cases, we believe that the companies expected too much in the way of facilities for welding an intricate job."

Torit Manufacturing Co. Builds New Factory

A new building, having over 12,000 sq. ft. of floor space, has been built by the Torit Manufacturing Co., at Walnut & Exchange Sts., St. Paul, Minn., for their factory. An adjoining building is occupied by the company's welding shop, operating under the name of the St. Paul Welding & Manufacturing Co. A. E. Swanson, of the Torit company, reports that their business is the best for many years, and he is very optimistic about the future.

New Home of Torit Manufacturing Co. and Its Welding Subsidiary.

A 1-story addition of 12,000 sq. ft. is being built to the present Hollup Corp. factory at 3357 West 47th Place, Chicago, Ill. The addition will be of brick and of the same style of architecture as the present factory, according to T. S. Wright, general manager, and is expected to be completed by Sept. 1 at a

cost of about $25,000. The company's old factory, located a short distance southeast of the present plant, will be used only as a warehouse.

Dr. F. H. Hensel, research engineer of P. R. Mallory & Co., Inc., Indianapolis, Ind., sailed on July 18 for a 3-months' trip to Japan, where he will study metallurgical progress in that country, both in the ferrous and non-ferrous fields. Dr. Hensel will visit research laboratories connected with the universities, as well as those of industries, and will make quite an extensive survey of plant operations and production methods.

Wayne H. McGlade, formerly assistant county engineer of Sumner County, Kansas, at Wellington, has become associated with the J. D. Adams Manufacturing Co., Indianapolis, Ind. While with Sumner County, Mr. McGlade made quite an enviable reputation for himself as a designer and fabricator using the shielded-arc method of welding on shop and road machinery as well as bridges.

The Southern California Equipment Repair Co., featuring service repairs on acetylene-welding equipment, recently moved from the old headquarters at 237 E. Avenue 40, Los Angeles, to its new location at 3730 Pasadena Ave., in Los Angeles.

The Republic Steel Corp., Cleveland, O., announces the appointment of the Conner Manufacturing Co., Louisville, Ky., and Chas. Miller & Son Co., Utica, N. Y., as distributors of Enduro stainless steels.

The Metallizing Engineering Co., of New York and Chicago, recently opened a branch office at 6432 Cass Ave., Detroit, Mich., with J. Hammond, formerly of the New York office, as manager.

The Hart Welding Supply Co. has opened a new branch office at 1819 Congress St., Houston, Texas, under the management of L. G. Newman, vice-president of the company.

The Michiana Products Corp., of Michigan City, Ind., have appointed O. Q. Swanson as their Michigan representative, with offices at 2842 W. Grand Blvd., Detroit.

The Machinery & Welder Corp., of St. Louis, Mo., announce the addition of K. R. Setterblade to their Chicago office and F. R. Cramer to their Kansas City office.

E. J. Henke, president of the American Electric Fusion Corp., of Chicago,

You can braze strong, reliable STAINLESS STEEL-CARBON STEEL *joints*

with **EASY-FLO** BRAZING ALLOY *and* **HANDY FLUX**

For example, look at this new "flexible" steering wheel, made by Sheller Mfg. Co. of Portland, Ind. A simple job, yet it calls for strong joints between hardened stainless spokes and a soft steel rim. EASY-FLO and HANDY FLUX solved the problem because—

1. **They make permanent joints between dissimilar metals at low temperature.**
2. **HANDY FLUX dissolves all oxides including chrome oxides. It starts cleaning metals at 900° F.—at 1200° F. it is entirely fluid and active.**
3. **EASY-FLO—fast flowing at 1175° F. penetrates rapidly—alloys with the metals—makes them one strong, ductile piece.**
4. **Rapid heating to such low temperatures leaves the stainless and physical qualities of the spokes and rim unimpaired.**
5. **So little EASY-FLO is used per wheel that its cost per joint, even though it contains a medium percentage of silver, is exceptionally low—gas and labor costs are low too.**

Try this fast working brazing combination on your dissimilar metal jobs or where metal (either ferrous or non-ferrous) is thin or parts small and other methods are impractical or expensive. Write for full details.

HANDY AND HARMAN
82 Fulton St., New York

Ill., sailed for Europe on June 30, on a business trip, and expects to return in August.

T. R. Baker, who has been welding sales demonstrator in the Chicago territory for the Steel Sales Co., 129 S. Jefferson St., Chicago, has been transferred to St. Louis, Mo., in the same capacity.

Notes From the Field

Some interesting figures were revealed recently when United States Army engineers, of the Cincinnati district, opened bids for the construction of two steel dump scows, requiring approximately 200 tons of steel plates and shapes. The Treadwell Construction Co., of Midland, Pa., submitted a low bid of $39,400 for the riveted type. The Dravo Contracting Co., of Pittsburgh, Pa., on the other hand, submitted a bid of $49,800 riveted and $45,800 for the welded type. Other bids included those of Charles Hegewald, New Albany, Ind., $51,400 riveted and $50,000 welded, and Ingalls Iron Works, Birmingham, Ala., $43,500 for the welded type only.

Considerable welding is being used in reinforcing work, in connection with the widening by the state highway departments of Kansas and Missouri of the Intercity Viaduct, 1⅞ miles long, connecting Kansas City, Kan., and Kansas City, Mo. To the main load-carrying members are being welded 540 stiffeners, and the corroded floor beams are being reinforced by welded steel plates. Welding is also being used in attaching clips to sidewalk beams, and in the 16,000 ft. of guard rail. The Stroebel Construction Co., of Chicago, Ill., has the contract for the erection of the steel.

Prow & Leffler, of El Monte, Calif., pioneers in the welding industry in that district, recently completed an extensive welding contract for Gay's Lion Farm, of that town. The main arena where the animals are trained and where daily acts are given, was completely rebuilt, welded steel being employed in the reinforcing and bracing of the large cage. The old wooden doors and corner posts were also replaced with ones of all-welded steel. To one who has seen these large "eats" act, the "safety-first" policy of welded steel seems quite appropriate and justifiable.

The Atlas Boiler & Welding Works, 205 South 9th St., Louisville, Ky., has just finished a pipe-welding job in a cooling system at the Dant and Head Distillery, Gethsemane, Ky. What will be the country's largest distillery, the Seagram Distillery, in Louisville, is reaching completion, and all the scale hoppers in it were made by the Atlas company, which also has a contract at this time for the construction of two steel smokestacks at the Fairfield Distilling Co., Bardstown, Ky.

The American Welding & Manufacturing Co. recently opened for business at Florence Ave. and Alameda Blvd., in Huntington Park, Calif. Ed Hanson and C. H. Ekins, partners in the new enterprise will feature general job welding. The shop is equipped for both shop and field jobs, and the operators are also designers and builders of all types of special industrial machinery. They formerly operated in Huntington Park under the name of the Gas-Arc Welding Works.

Launching and delivery of the all-welded steel hull for the Pittsburgh Coal Co.'s steamer *Cruiser* is expected at an early date from the marine ways of the Dravo Contracting Co. on Neville Island, a few miles below Pittsburgh. The hull is of the stern-wheel type, 145 ft. long, 32 ft. wide and 6.4 ft. deep, and will be taken to the Elizabeth, Pa., marine ways, where the cabin and machinery of the steamer will be moved from the wooden hull.

Francis W. Haines, who is a partner with his father in the Wolverine School of Trades, of Detroit, Mich., has registered the name of the Detroit Welding School, at 3880 Helen Ave., Detroit. The former Detroit School of Welding has been dissolved, and the former Detroit Welding School, at 1620 W. Lafayette, has just been closed. Neither had any connection with the present planned school, according to Haines.

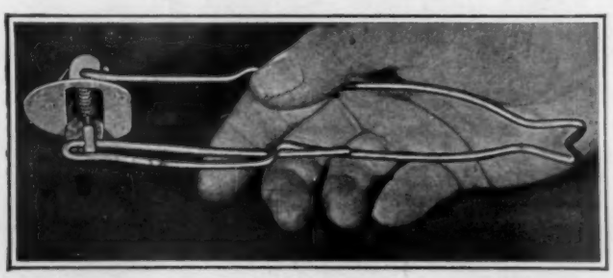
Sheet-metal roofing is being laid and welded on rackhouse No. 5 at Hiram Walkers distillery, in Peoria, Ill. The Fenestra Construction Co. of Chicago have the contract for this roof and are renting welding equipment from The Superior Welding Co. of Peoria. The Fenestra company also has the contract for a sheet-metal roof to be put on a new building at The Caterpillar Tractor Co. in East Peoria.

A contract for the construction of an all-welded steel cattle barge, to be 196 ft. long, 36.6 ft. wide and 8 ft. deep, for the Jersey City Stockyards Co., has been awarded the Dravo Contracting Co. The plates and shapes will be fabricated at the Dravo company's Neville Island yards and shipped to their Wilmington plant, where they will be erected. Delivery will be made in September.

An all-welded steel brine tank is being installed at the Armour & Co. packing plant in Peoria, Ill. It is 16 ft. 6 in. long, 5 ft. 6½ in. wide and 4 ft. 3 in. deep. The sheets for this tank were delivered to the site, and lowered three floors to the basement, where they were set up and welded. Welding was done by The Superior Welding Co., of Peoria.

John E. Meyers, associated with the Louisville Brazing & Machine Co.,

The Improved "Round File" Gas Lighter



Many superior design and construction features, found only in Improved "Round File," make this lighter the Welder's Favorite.

Hood forms a pocket for gas, insuring immediate ignition.
Larger file area, providing longer life for lighter.
Larger spark metal, which assures many additional ignitions.
Locking slip-on renewal cartridge, permits immediate replacement.
Cadmium plated, preventing rust.
Every part **thoroughly tested.**
Fully guaranteed.

Write for descriptive circulars and prices.

CAUTION: Imitations of the patented Improved "Round File" are on the market. For your protection insist on Safety Gas Lighter Co. patented lighters and genuine Safety Gas Lighter Co. renewals.

ORIGINATORS OF THE HAND GAS LIGHTERS **SAFETY GAS LIGHTER CO.** Est. 1901 **LYNN, MASS.**

ouisville, Ky., died recently of pneu-onia. He was widely known in welding reles, having been connected with weld-g concerns in Dayton, Ohio, Detroit, d Buffalo, before coming to Louisville. uring the World War he was a super-tendent at the Hog Island shipyards.

The first welded bridge to be built by omanche County, Kansas, has just been ompleted at Clearwater, under the su-ervision of J. E. Schrock, county en-neer. It is a 40-ft. structure, composed two 20-ft. spans. A new 200-ft. idge of this same design is now under ay.

The American Bureau of Shipping is rveying a fleet of 10 steel barges of the all-welded type that are now in process of erection at the Neville Island plant of the Dravo Contracting Co., of Pittsburgh, Pa., for the Keystone Sand & Supply Co. of that city. All the barges are of standard coal-carrying size, 175 ft. long.

The Ohio River Co., of Cincinnati, a subsidiary of the West Virginia Coal & Coke Co., are reported in the market for 5 all-welded barges for transporting coal from the Huntington, W. Va., district to Cincinnati. The barges will be 195 ft. long, 35 ft. wide and 11 ft. deep.

Metallizers of Milwaukee, Milwaukee, Wis., have increased their capital, installed an additional metal-spray gun, changed their name to National Metallizing Works, and moved to much enlarged quarters at 2625 North 30th St. A. W. Hoeppner is general manager. Their former address was 3266 North 33rd St.

A new factory, to be devoted exclusively to metal spraying, is being erected by Consani's Engineering (Proprietary) Ltd., Salt River, Capetown, South Africa, erectors and fabricators of welded structures.

The A. O. Smith Corp. have made a one-story addition to one of their plants, using pipe for upright supports, and plates for the sides and tops, all of which was arc welded.

· CLASSIFIED ADS ·

elp Wanted—75c per line. minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line. minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

FOR SALE

BARGAINS—Aladdin A. C. Welder, new.....$ 25.00
Modern A. C. Welder, new..... 49.50
100-amp. electric-drive welder..... 175.00
300-ampere gas-engine welder..... 350.00
400-ampere gas-engine welder..... 550.00
Address Jul-5, The Welding Engineer.

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Engineer & Shop Foreman—Wanted by manufacturer emoying considerable welding. Must be able to handle men in e shop and get top-notch results. Interest offered in comny. H. C. Schildmeier Co., 956 Massachusetts Ave., Inianapolis, Ind.

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MISCELLANEOUS

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Shop Manager—Retiring from own business, wishes to make connection with boiler, tank or plate shop. 18 years' experience in management, including designing, estimating, selling and erecting tanks and miscellaneous equipment in the field. Also extensive experience in large and small job shops. Will work on percentage or salary. A-1 references; age 39; married. Clifford A. Dobyns, 528 S. Water St., Wichita, Kan.

Inspector, Supervisor and Instructor of Welding—Specialized 8 years in arc welding. Practical welder. Knowledge of metallography, heat-treating and physical metallurgy. Capable of performing all tests and investigations of weld metal. Has had sales experience. Member of A. W. S. and A. S. M. Knowledge of foreign languages. Consider position outside U. S. A. Address Jul-6, The Welding Engineer.

Welding Service Man—Knowledge of thermit, gas and electric welding, oxyacetylene heat-treating and cutting. Several years' experience. Demonstrative and sales ability. Mechanically inclined. Age 26. Address Jul-3, The Welding Engineer.

Heavy Welding and Boiler Repair Salesman—Practical oxyacetylene and electric experience. Best references. Can instruct and supervise. Will go anywhere. Address Jul-4, The Welding Engineer.

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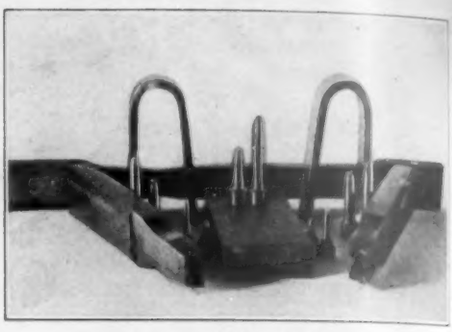

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